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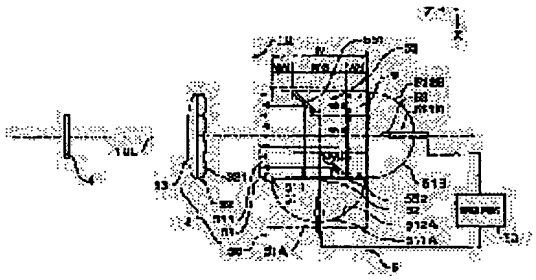
(54) LIGHTING DEVICE AND PROJECTION TYPE DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a lighting device capable of performing a bright and uniform lighting without color irregularity by extracting the part of emitted light included in a fixed range including a lamp optical axis among the light emitted from respective lamp units and forming synthesized luminous flux for illumination whose width is identical to the diameter of an aperture edge.

SOLUTION: The center light whose width including the lamp optical axis 52 is about 1/2W among the light emitted from the first lamp unit 51A is reflected on reflection mirrors 551 and 552 and advanced toward an integrator optical system 3. The emitted light other than it is not utilized as the illumination light. The center light whose width including the optical axis 53 is about 1/2W among the light emitted from the second lamp unit 51B is made incident on the optical system 3 as it is. The emitted light on both sides is not utilized. As the result, the synthesized luminous flux obtained by synthesizing the emitted light parts whose width including the central parts of the light emitted from both units 51A and 51B are about 1/2W is made incident on the first lens plate 31 of the optical system 3.



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CLAIMS

[Claim(s)]

[Claim 1] In the lighting system which has the lamp unit equipped with the light source lamp and the reflector which reflects the outgoing radiation light from the light source lamp concerned so that it may become an outgoing radiation light parallel as a whole The 1st and said 2nd lamp unit, The lighting system characterized by having a synthetic mirror means to take out the outgoing radiation light part contained in the fixed range including the lamp light shaft of each outgoing radiation light from each lamp unit, and to form the synthetic flux of light the diameter of the opening edge of a lamp unit, and for the lighting of abbreviation same width of face.

[Claim 2] It is the lighting system characterized by being attached so that the reflective mirror of the pair by which the reflector of each lamp unit reflects a part of outgoing radiation light in the opening edge by the side of the outgoing radiation in claim 1 may be in a condition symmetrical with abbreviation mutually considering a lamp light shaft as a core.

[Claim 3] It is the lighting system with which parts other than the fixed range where said reflector of said 1st and 2nd lamp units includes said lamp light shaft in claim 1 are characterized by having the configuration which intersected perpendicularly with the effective area of said lamp unit, and was mutually cut at the flat surface symmetrical with abbreviation considering said each lamp light shaft as a core.

[Claim 4] In one term of claims 1-3 said 1st lamp unit It is arranged so that the lamp light shaft may cross the lamp light shaft of said 2nd lamp unit. The lighting system characterized by having said synthetic mirror means to reflect in the lamp light shaft orientations of said 2nd lamp unit the outgoing radiation light contained in the fixed range which includes the lamp light shaft among the outgoing radiation light from said 1st lamp unit.

[Claim 5] The lighting system characterized by said 1st lamp unit consisting of said synthetic mirror means and one removable in claim 4.

[Claim 6] In one to claims 1-3 of terms said synthetic mirror means The 1st synthetic mirror means for taking out the outgoing radiation light part contained in the fixed range including the lamp light shaft of the outgoing radiation light from said 1st lamp unit, The lighting system characterized by having the 2nd synthetic mirror means for taking out the outgoing radiation light part contained in the fixed range including the lamp light shaft of the outgoing radiation light from said 2nd lamp unit.

[Claim 7] It is the lighting system characterized by one of lamp units at least being removable of said 1st and 2nd lamp units in claim 6.

[Claim 8] It is the lighting system characterized by one [at least] side of said 1st lamp unit and said 1st synthetic mirror means, and said 2nd lamp unit and said 2nd synthetic mirror means being removable in one in claim 7.

[Claim 9] It is the lighting system characterized by equipping alternatively said 1st and 2nd lamp units with the control circuit which can be turned on further in claims 4 or 6.

[Claim 10] The lighting system characterized by the wavelength distribution properties of the light by which outgoing radiation is carried out from the light source lamp of two or more of said lamp units differing in claims 4 or 6, respectively.

[Claim 11] It has the integrator optical system containing the 2nd lens plate which has the 1st lens plate and two or more lenses which has further two or more lenses in claim 1. Said 1st lens plate While generating two or more middle flux of lights by separating said synthetic flux of light spatially with each lens The lighting system characterized by overlapping a predetermined lighting field on said two or more middle flux of lights of each by which were made to converge said two or more middle flux of lights as a secondary light source image near the plane of incidence of each lens of said 2nd lens plate, respectively, and outgoing radiation was carried out through each lens of the 2nd lens plate concerned.
[Claim 12] It has the polarization generating means which changes and carries out outgoing radiation of the outgoing beam from said 2nd lens plate to one kind of polarization flux of light to which the polarization direction was equal further in claim 11. Said polarization generating means A polarization separation means to divide the outgoing beam from said 2nd lens plate into two kinds of polarization flux of lights from which the polarization direction differs mutually, It has the polarization conversion means which while was obtained by said polarization separation means, and carries out polarization conversion of the polarization direction of the polarization flux of light so that it may become the same as the polarization direction of the polarization flux of light of another side. The lighting system characterized by illuminating said lighting field according to one kind of polarization flux of light to which said polarization direction acquired by said polarization generating means was equal.
[Claim 13] The projection mold display characterized by having the lighting system indicated by either of claims 1, 11, or 12, a modulation means to modulate the outgoing radiation light from said lighting system according to image information, and the projection optical system which projects the modulation flux of light acquired with said modulation means on a projection side.
[Claim 14] A color separation means to divide the outgoing radiation light from said lighting system into the colored light bundle of at least 2 colors further in claim 13, Said two or more modulation means to modulate each colored light bundle separated by said color separation means, respectively, The projection mold display characterized by projecting the synthetic flux of light which has a color composition means to compound the modulation flux of light of each color after becoming irregular with said each modulation means, and was acquired by said color composition means on a projection side through said projection optical system.
[Claim 15] When three directional axes which intersect perpendicularly mutually are set to X, Y, and Z in a projection mold display according to claim 14 and a direction parallel to the optical axis of the outgoing radiation light from said lighting system is set to Z, said color separation means It has a color separation side so that a predetermined include angle may be accomplished to YZ flat surface and XY flat surface to an abbreviation perpendicular to XZ flat surface, respectively. Two or more of said lamp units and said synthetic mirror means The projection mold display characterized by being arranged so that the outgoing radiation light from said two or more lamp units may be compounded along the direction of abbreviation Y.
[Claim 16] When three directional axes which intersect perpendicularly mutually are set to X, Y, and Z in a projection mold display according to claim 14 and a direction parallel to the optical axis of the outgoing radiation light from said lighting system is set to Z, said color composition means It has a die clo IKKU side. Said die clo IKKU side It is arranged so that a predetermined include angle may be accomplished to YZ flat surface and XY flat surface to an abbreviation perpendicular to XZ flat surface. Two or more of said lamp units and said synthetic mirror means The projection mold display characterized by being arranged so that the outgoing radiation light from said two or more lamp units may be compounded along the direction of abbreviation Y.
[Claim 17] It is the lighting system which illuminates the lighting field of the abbreviation rectangle configuration of having two or more sides parallel to the 1st direction which carries out an abbreviation rectangular cross mutually, or the 2nd direction. The 1st and the 2nd lamp unit, A synthetic mirror means to picking-take out the outgoing radiation light part contained in the fixed range including the lamp light shaft of each outgoing radiation light from each lamp unit, respectively, to compound it, and to

form the diameter of the opening edge of a lamp unit, and the illumination light of abbreviation same width of face, While dividing the light source which ****, and the flux of light by which outgoing radiation was carried out from said light source into two or more partial flux of lights The 1st lens plate which has two or more small lenses which make these two or more partial flux of lights condense, respectively, The 2nd lens plate which has two or more small lenses in which said two or more partial flux of lights carry out incidence, A polarization separation means to separate two or more partial flux of lights by which outgoing radiation was carried out into two kinds of polarization flux of lights from which the polarization direction differs mutually, respectively from said 2nd lens plate, It has the polarization conversion means which while was obtained by this polarization separation means, and carries out polarization conversion of the polarization direction of the polarization flux of light so that it may become the same as the polarization direction of the polarization flux of light of another side. The polarization generating means which changes and carries out outgoing radiation of said two or more partial flux of lights to one kind of two or more polarization flux of lights to which the polarization direction was equal, It has a superposition means to superimpose two or more polarization flux of lights by which outgoing radiation was carried out from said polarization generating means, and to illuminate said lighting field. Said polarization separation means It is arranged so that said two kinds of polarization flux of lights may be spatially separated along said 1st direction of said lighting field. Each smallness lens of said 1st lens plate The configuration projected on a flat surface perpendicular to the main optical axis of each of said smallness lens is an abbreviation rectangle. And the value of the aspect ratio of said abbreviation rectangle configuration is almost equal to the value of the aspect ratio of said lighting field. It is formed so that two or more partial flux of lights by which outgoing radiation is carried out from said each smallness lens may carry out incidence to each smallness lens with which said 2nd lens plate corresponds. Each smallness lens of said 2nd lens plate The configuration projected on a flat surface perpendicular to the main optical axis of each of said smallness lens is an abbreviation rectangle. And the value of the aspect ratio of said abbreviation rectangle configuration It is the lighting system defined by the rate of the die length of the side parallel to said 2nd direction [as opposed to / have a value smaller than the value of the aspect ratio of said lighting field, and / the die length of the side where the value of said aspect ratio is parallel to said 1st direction].

[Claim 18] The value of said aspect ratio of each smallness lens of said 2nd lens plate is a lighting system according to claim 17 which is about 1/2.

[Claim 19] Two or more trains which met in said 2nd direction of two or more small lenses which constitute said 2nd lens plate are lighting systems according to claim 17 characterized by being adjusted so that the magnitude which met in said 2nd direction of each smallness lens which constitutes said each train may become small as it separates from said light source to the center position of the flux of light by which outgoing radiation was carried out.

[Claim 20] The lighting system characterized by having the control circuit which can selection turn either on among the light source lamps of two or more of said lamp units in a lighting system according to claim 17.

[Claim 21] The lighting system characterized by the wavelength distribution properties of the light by which outgoing radiation is carried out from the light source lamp of two or more of said lamp units differing in a lighting system according to claim 17, respectively.

[Claim 22] The projection mold display characterized by having a lighting system according to claim 17, a modulation means to modulate the outgoing radiation light from said lighting system according to image information, and the projection optical system that projects the modulation flux of light acquired with said modulation means on a projection side.

[Claim 23] A color separation means to divide the outgoing radiation light from said lighting system into the colored light bundle of at least 2 colors further in claim 22, Said two or more modulation means to modulate each colored light bundle separated by said color separation means, respectively, The projection mold display characterized by projecting the synthetic flux of light which has a color

composition means to compound the modulation flux of light of each color after becoming irregular with said each modulation means, and was acquired by said color composition means on a projection side through said projection optical system.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] It is compact and this inventions are small [which consists of two or more lamp units], and a thing about a lighting system with high efficiency for light utilization. Moreover, this invention relates to the projection mold display which can form a uniform and bright projection image using the lighting system of this format.
[0002]
[Description of the Prior Art] The lighting system built into a projection mold display etc. is equipped with the lamp unit of a configuration of that the reflector which carries out outgoing radiation is included in the predetermined direction as parallel light or a focusing light by reflecting the synchrotron orbital radiation by which outgoing radiation was carried out from light source lamps, such as a halogen lamp and a metal halide lamp, and this light source lamp. As a reflector, things, such as a paraboloid form and an ellipsoid form, are used for the configuration of the reflector.
[0003] Moreover, as for a lighting system, what has many outgoing radiation quantity of lights is desirable so that a uniform and bright projection image can be formed in the lighting system used for a projection mold display. Moreover, if shown in the projection mold display of a portable mold, the lighting system incorporated there from the request of the small miniaturization is also small, and a compact thing is desirable.
[0004]
[Problem(s) to be Solved by the Invention] In order to make [many] the outgoing radiation quantity of light of a lighting system, it is possible to constitute a lighting system using two or more lamp units, for example, a two lamp unit. However, if a two lamp unit is only made the configuration arranged to juxtaposition, since width of face will double, a lighting system will be enlarged. Moreover, since the width of face of the outgoing beam of a lighting system also becomes twice, it is necessary to also make large optical-path width of face of a lighting system, and it is necessary to also expand the optical-path width of face which should be formed in the projection mold display side with which the lighting system concerned was incorporated further twice, and unsuitable to a miniaturization and miniaturization of equipment also in this point.
[0005] Here, as a typical example of the lighting system built into the projection mold display, in order to secure the parallelism of outgoing radiation light, the lamp unit equipped with the reflector of the paraboloid configuration where a light source lamp with the short arc length and a focal distance are short is known. In the lamp unit of this configuration, quantity of light distribution of the outgoing

radiation light from there shows a lamp light shaft and a peak steep in that near, and serves as a characteristic curve which follows on separating from a lamp light shaft, and decreases to rapid decrease. Therefore, even if it uses only the outgoing beam for a core including a lamp light shaft as illumination light, the fall of the quantity of light is not caused so much. In addition, in the general lamp unit adopted as a projection mold display, the line which connected the core of the effective area of a reflector and the center of curvature of a reflector can define a lamp light shaft.

[0006] In view of the above-mentioned point, in the lighting system using two or more lamp units, and the projection mold display with which such a lighting system was incorporated, the technical problem of this invention is bright, and its brightness is uniform, and it is to propose the possible technique of obtaining a projection image without an irregular color.

[0007]

[The means for solving a technical problem, and its operation and effectiveness]

In order to solve an above-mentioned technical problem, (The 1st lighting system and projection mold display using this) The 1st lighting system of this invention In the lighting system which has the lamp unit equipped with the reflector which reflects the light by which outgoing radiation is carried out from a light source lamp and the light source lamp concerned so that it may become an outgoing radiation light parallel as a whole The 1st and said 2nd lamp unit, It is characterized by having a synthetic mirror means to take out the outgoing radiation light part contained in the fixed range including the lamp light shaft of each outgoing radiation light from each lamp unit, and to form the synthetic flux of light the diameter of the opening edge of a lamp unit, and for the lighting of abbreviation same width of face.

[0008] Thus, in the 1st constituted lighting system of this invention, although the tooth space for arranging two lamp units is required, the width of face of the synthetic flux of light acquired by the synthetic mirror means is almost the same as the width of face of the outgoing beam of a single lamp unit. And a part for the core of outgoing radiation light including a lamp light shaft with much outgoing radiation quantity of light of each lamp unit is used by the synthetic mirror means. Therefore, in the projection mold display with which the 1st lighting system of this invention was incorporated, since what is necessary is just to secure the case of the lighting system equipped with the single lamp unit as an optical path of the illumination light, and the space which arranges the optical path of the same width of face mostly, the equipment dimension except a lighting system does not increase. Moreover, since the synthetic flux of light is formed using a part with much quantity of light of the outgoing radiation light of each lamp unit, if the illumination light with much outgoing radiation quantity of light can be obtained and the 1st lighting system of this invention is built into a projection mold display, a bright projection image can be formed.

[0009] What is necessary is just to raise further the use effectiveness of the outgoing radiation light of each lamp unit, in order to make [more / still] the quantity of light of the illumination light of the lighting system of this configuration. What is necessary is for that just to adopt the configuration attached so that it may be in a condition symmetrical with abbreviation mutually considering a lamp light shaft as a core about the reflective mirror of a pair by which a part of outgoing radiation light is reflected in the opening edge by the side of the outgoing radiation of the reflector of each lamp unit. According to this configuration, it is reflected by the reflective mirror and is again reflected by the reflector return and here, and the outgoing radiation light of a part far from a lamp light shaft passes the part near a lamp light shaft, and outgoing radiation is carried out. Therefore, it is used, in order that outgoing radiation of most outgoing radiation light of each lamp unit may be carried out to a synthetic mirror means side and it may form the synthetic flux of light for lighting.

[0010] Here, said reflector of said 1st and 2nd lamp units shall have the configuration from which the effective area of said lamp unit and parts other than the fixed range including said lamp light shaft crossed at right angles, and each other were cut at the symmetrical flat surface considering said each lamp light shaft as a core. the part from which the reflector was cut by such configuration -- each lamp unit -- a synthetic mirror means side -- or it becomes possible to miniaturize the projection mold

display with which it can arrange to an illuminated field side, and enables it to miniaturize a lighting system, and this lighting system is incorporated.

[0011] Moreover, said 1st lamp unit can be arranged so that that lamp light shaft may cross the lamp light shaft of said 2nd lamp unit, and it should just constitute said synthetic mirror means so that the outgoing radiation light contained in this case in the fixed range which includes that lamp light shaft among the outgoing radiation light from said 1st lamp unit may be reflected in the lamp light shaft orientations of said 2nd lamp unit. Moreover, in this case, if said 1st lamp unit is constituted from said synthetic mirror means and one removable, when a miniaturization and lightweight-izing of a lighting system can be realized and it thinks portability as important, it is convenient by removing the 1st lamp unit and synthetic mirror means according to an application.

[0012] It can also consider as the configuration equipped with the 2nd synthetic mirror means for taking out the outgoing radiation light part contained in the fixed range including the lamp light shaft of the outgoing radiation light from the 1st synthetic mirror means for taking out the outgoing radiation light part contained in said synthetic mirror means on the other hand in the fixed range including the lamp light shaft of the outgoing radiation light from said 1st lamp unit, and said 2nd lamp unit. Of said 1st and 2nd lamp units, in this case, make one of lamp units removable at least, or One [at least] side of said 1st lamp unit and said 1st synthetic mirror means, and said 2nd lamp unit and said 2nd synthetic mirror means or by making it removable in one A miniaturization and lightweight-izing of a lighting system can be realized and it becomes usable according to an application.

[0013] In addition, usage various in respect of the brightness demanded since the brightness of the illumination light can be adjusted to a multistage story if needed, or consumed electric power possible [selection lighting of either] among the light source lamps of two or more of said lamp units then becomes possible.

[0014] Moreover, when making it the wavelength distribution properties of the light by which outgoing radiation is carried out from the light source lamp of two or more of said lamp units differ, respectively, and the tint of the illumination light can be set as a predetermined tint and it applies to a color projection mold display, it is possible to raise the color reproduction nature.

[0015] Next, in order to lose the illuminance nonuniformity of the illumination light by the 1st lighting system of this invention, it is desirable to consider as the configuration equipped with integrator optical system. Namely, it has the integrator optical system containing the 2nd lens plate which has the 1st lens plate and two or more lenses which has two or more lenses. Said synthetic flux of light is completed as a secondary light source image on the plane of incidence of each lens of said 2nd lens plate, respectively as two or more middle flux of lights spatially separated through each lens of said 1st lens plate. It is desirable to superimpose said two or more middle flux of lights of each by which outgoing radiation was carried out through each lens of the 2nd lens plate concerned, and to illuminate a lighting field. Even when it has the bias to the optical intensity distribution in the cross section of the flux of light with the big outgoing beam from a lamp unit by such configuration, it becomes brightness is uniform and possible to obtain the illumination light without brightness or an irregular color.

[0016] Furthermore, a polarization separation means to separate into two kinds of mutually different polarization flux of lights the synthetic flux of light with the random polarization direction by which outgoing radiation was carried out from the 2nd lens plate, It has the polarization conversion means which while was obtained by this polarization separation means, and carries out polarization conversion of the polarization direction of the polarization flux of light so that it may become the same as the polarization direction of the polarization flux of light of another side. You may make it illuminate a lighting field using the polarization generating means which changes and carries out outgoing radiation of said two kinds of polarization flux of lights to one kind of polarization flux of light to which the polarization direction was equal according to one kind of polarization flux of light to which the polarization direction acquired by this polarization generating means was equal.

[0017] Since only about one kind of polarization flux of light to which the polarization direction was equal

can be used as illumination light according to the above-mentioned configuration, when building this lighting system into a projection mold display etc. so that it may mention later, it is possible to raise the use effectiveness of light. In addition, in the process in which about one kind of polarization flux of light to which the polarization direction was equal is acquired from the flux of light with the above-mentioned random polarization direction, since it is hardly accompanied by light absorption, it is possible to acquire the specific polarization flux of light at very high effectiveness.

[0018] The lighting system equipped with the synthetic mirror means expressed above can be used as a lighting system of a projection mold display. What is necessary is just to constitute the modulation flux of light acquired with a modulation means to modulate the outgoing radiation light from the 1st lighting system of this invention, and said lighting system as a projection mold display according to image information, and said modulation means using the projection optical system projected on a projection side. Although the tooth space for arranging two lamp units is required in the 1st lighting system of this invention as stated above, the width of face of the synthetic flux of light acquired by the synthetic mirror means is almost the same as the width of face of the outgoing beam of a single lamp unit. And a part for the core of outgoing radiation light including a lamp light shaft with much outgoing radiation quantity of light of each lamp unit is used by the synthetic mirror means. Therefore, in the projection mold display into which the 1st lighting system of this invention was built, since what is necessary is just to secure the case of the lighting system equipped with the lamp unit single as an optical path of the illumination light, and the space which arranges the optical path of the same width of face mostly, the dimension of the equipment except a lighting system does not increase. Therefore, it becomes possible to raise the brightness of a projection image with equipment size almost comparable as the case where a single lamp unit is used.

[0019] Brightness is uniform, even when integrator optical system is prepared in said lighting system and it has the bias to the optical intensity distribution in the cross section of the flux of light with the big outgoing beam from a lamp unit, since it becomes possible to obtain the illumination light without brightness or an irregular color, brightness is uniform over the whole projection side here, and a projection image without brightness or an irregular color can be obtained.

[0020] Furthermore, you may make it illuminate a modulation means according to one kind of polarization flux of light to which a polarization generating means to have a polarization separation means which was mentioned above, and a polarization conversion means was formed in said lighting system, and the polarization direction was equal to it.

[0021] In the projection mold display equipped with the modulation means using one kind of polarization flux of light like liquid crystal equipment, when the polarization direction uses the random flux of light as illumination light, in order to have to choose as a display the polarization flux of light from which the unnecessary polarization direction differs with polarization selection means, such as a polarizing plate, the use effectiveness of light falls extremely. Moreover, since the temperature of a polarizing plate rises remarkably by the absorption of light in using a polarizing plate as a polarization selection means, the large-scale cooling system for cooling a polarizing plate is required. However, according to the above-mentioned configuration, the flux of light from a lighting system with the random polarization direction can be changed into the polarization flux of light which has about one kind of polarization direction as a whole, and only about one kind of polarization flux of light to which the polarization direction was equal can be used as available illumination light with a modulation means. Therefore, it becomes possible to use most outgoing beams from a light source lamp, and it becomes possible to obtain a very bright projection image. Moreover, since the polarization flux of light from which the unnecessary polarization direction differs in a display is hardly included in the illumination light, it is few, therefore large simplification of the cooling system which cools a polarizing plate, and the miniaturization of the light absorption in a polarizing plate are attained.

[0022] In order to indicate the color picture by projection, in the above-mentioned configuration In addition, in addition, a color separation means to divide the outgoing radiation light from a lighting

system into the colored light bundle of at least 2 colors, Said two or more modulation means to modulate each colored light bundle separated by said color separation means, respectively, What is necessary is to have a color composition means to compound the modulation flux of light of each color after becoming irregular with said each modulation means, and just to consider as the configuration on which the synthetic flux of light acquired by said color composition means is projected on a projection side through said projection optical system.

[0023] When three directional axes which intersect perpendicularly mutually are set to X, Y, and Z and a direction parallel to the optical axis of the outgoing radiation light from said lighting system is set to Z, moreover, said color separation means It has a color separation side so that a predetermined include angle may be accomplished to YZ flat surface and XY flat surface to an abbreviation perpendicular to XZ flat surface, respectively. Two or more of said lamp units and said synthetic mirror means Being arranged is desirable so that the outgoing radiation light from said two or more lamp units may be compounded along the direction of abbreviation Y.

[0024] Thus, since the outgoing radiation light from each lamp unit is compounded in the optical separation direction of the die clo IKKU side of a color separation means, and the direction which intersects perpendicularly when a projection mold display is constituted, each outgoing radiation light of all from each lamp unit carries out incidence by the equal incident angle to the die clo IKKU side. Therefore, the color gap of each colored light by which outgoing radiation is carried out toward a modulation means from a die clo IKKU side can be reduced. For this reason, brightness is uniform and a lighting field can be illuminated by the illumination light without brightness or an irregular color.

[0025] When three directional axes which intersect perpendicularly mutually are set to X, Y, and Z and a direction parallel to the optical axis of the outgoing radiation light from said lamp unit is set to Z, moreover, said color composition means It has a die clo IKKU side. Said die clo IKKU side It is arranged so that a predetermined include angle may be accomplished to YZ flat surface and XY flat surface to an abbreviation perpendicular to XZ flat surface. Two or more of said lamp units and said synthetic mirror means Being arranged is also desirable so that the outgoing radiation light from said two or more lamp units may be compounded along the direction of abbreviation Y.

[0026] Thus, since the outgoing radiation light from each lamp unit is compounded in the optical separation direction of the die clo IKKU side of a color composition means, and the direction which intersects perpendicularly when a projection mold display is constituted, each outgoing radiation light of all from each lamp unit carries out incidence by the equal incident angle to the die clo IKKU side. Therefore, the color gap of the synthetic flux of light by which outgoing radiation is carried out toward projection optical system from a die clo IKKU side can be reduced. For this reason, brightness is uniform and a uniform projection image can be obtained.

[0027] (The 2nd lighting system and projection mold display using this) The 2nd lighting system of this invention It is the lighting system which illuminates the lighting field of the abbreviation rectangle configuration of having two or more sides parallel to the 1st direction which carries out an abbreviation rectangular cross mutually, or the 2nd direction. The 1st and the 2nd lamp unit, A synthetic mirror means to picking-take out the outgoing radiation light part contained in the fixed range including the lamp light shaft of each outgoing radiation light from each lamp unit, respectively, to compound it, and to form the diameter of the opening edge of a lamp unit, and the illumination light of abbreviation same width of face, While dividing the light source which ****, and the flux of light by which outgoing radiation was carried out from said light source into two or more partial flux of lights The 1st lens plate which has two or more small lenses which make these two or more partial flux of lights condense, respectively, The 2nd lens plate which has two or more small lenses in which said two or more partial flux of lights carry out incidence, A polarization separation means to separate two or more partial flux of lights by which outgoing radiation was carried out into two kinds of polarization flux of lights from which the polarization direction differs mutually, respectively from said 2nd lens plate, It has the polarization conversion means which while was obtained by this polarization separation means, and carries out

polarization conversion of the polarization direction of the polarization flux of light so that it may become the same as the polarization direction of the polarization flux of light of another side. It has the polarization generating means which changes and carries out outgoing radiation of said two or more partial flux of lights to one kind of two or more polarization flux of lights to which the polarization direction was equal, and a superposition means to superimpose two or more polarization flux of lights by which outgoing radiation was carried out from said polarization generating means, and to illuminate said lighting field. Said polarization separation means is arranged so that said two kinds of polarization flux of lights may be spatially separated along said 1st direction of said lighting field. And each smallness lens of said 1st lens plate The configuration projected on a flat surface perpendicular to the main optical axis of each of said smallness lens is an abbreviation rectangle. And the value of the aspect ratio of said abbreviation rectangle configuration is almost equal to the value of the aspect ratio of said lighting field. It is formed so that two or more partial flux of lights by which outgoing radiation is carried out from said each smallness lens may carry out incidence to each smallness lens with which said 2nd lens plate corresponds. Each smallness lens of said 2nd lens plate The configuration projected on a flat surface perpendicular to the main optical axis of each of said smallness lens is an abbreviation rectangle, and the value of the aspect ratio of said abbreviation rectangle configuration is characterized by having and carrying out the value smaller than the value of the aspect ratio of said lighting field. However, the value of said aspect ratio is defined by the rate of the die length of the side parallel to said 2nd direction over the die length of the side parallel to said 1st direction.

[0028] Although the tooth space for arranging two lamp units is required of the 2nd lighting system of this invention like the 1st lighting system, the width of face of the synthetic flux of light acquired by the synthetic mirror means is almost the same as the width of face of the outgoing beam of a single lamp unit. And the flux of light for the core which includes a lamp light shaft with much outgoing radiation quantity of light in each lamp unit with a synthetic mirror means is used as an illumination-light bundle. Therefore, in the projection mold display with which the 2nd lighting system of this invention was incorporated, since what is necessary is just to secure the case of the lighting system equipped with the lamp unit single as an optical path of the illumination light, and the space which arranges the optical path of the same width of face mostly, the dimension of the equipment except a lighting system does not increase. Moreover, since the synthetic flux of light is formed using a part with much quantity of light of the outgoing radiation light of each lamp unit, if the illumination light with much outgoing radiation quantity of light can be obtained and the 2nd lighting system of this invention is built into a projection mold display, a uniform and bright projection image can be formed.

[0029] Here, each flux of light which passes each smallness lens of the 2nd lens plate is regarded as a mass of illumination-light bundle, and its attention is paid to the value of the aspect ratio of the cross-section configuration of the illumination-light bundle. In the 2nd lighting system of this invention, the 2nd lens plate Since it consists of small lenses which have a value smaller than the value of the aspect ratio of the small lens of the 1st lens plate, (It is almost equal to the value of the aspect ratio of a lighting field) The value of the aspect ratio of the illumination-light bundle of a top Norikazu settlement also becomes smaller than the value of the aspect ratio of a mass of illumination-light bundle acquired when the 2nd lens plate is constituted from two or more small lenses which have the value of the same aspect ratio as the small lens of the 1st lens plate. It doubles with the aspect ratio of the small lens of the 2nd lens plate. Namely, the cross-section configuration of an illumination-light bundle The 2nd lay length serves as the shape of a shorter rectangle to the 1st lay length (as mentioned above). In a mass of illumination-light bundle which passes the 2nd lens plate the aspect ratio of the cross-section configuration of an illumination-light bundle The illumination-light bundle changed according to the aspect ratio of the small lens which constitutes "the compressed illumination-light bundle", a call, and the 1st lens plate in the illumination-light bundle changed according to the aspect ratio of the small lens which constitutes the 2nd lens plate shall be called "the illumination-light bundle which is not compressed."

[0030] When this lighting system is applied to a projection mold display, the illumination-light bundle compressed in this way illuminates a projection side through a projection lens. In the case of the compressed illumination-light bundle, compared with the case of the illumination-light bundle which is not compressed, whenever [incident angle / at the time of an illumination-light bundle carrying out incidence to a projection lens] can be made small, and incidence of many illumination-light bundles can be carried out near the core of the lens pupil of a projection lens. Generally, the use effectiveness of the light in a lens is in the inclination which gets so bad that it is so good that it is close to the core of a lens pupil and close to the circumference. Therefore, when the 2nd lighting system of this invention is applied to a projection mold display, the outgoing radiation light from the light source can be used efficiently, and a uniform and bright projection image can be displayed.

[0031] Those cores shift and pass mostly especially the outgoing radiation light from two or more lamp units to the symmetry in the direction of the 2nd side to the main optical axis of the 2nd lens plate. As mentioned above, the use effectiveness of the light in a lens is in the inclination which gets so bad that it is so good that it is close to the core of a lens pupil and close to the circumference. Moreover, as the conventional example explained, in one lamp unit, there is the description that very, and the outgoing radiation quantity of light for a core including the optical axis of a light source lamp follows on separating from the optical axis of this light source lamp, and decreases rapidly. Therefore, in the lighting system of the above-mentioned configuration, since the width of face which met in the 2nd direction of the outgoing radiation light from each lamp unit is compressed centering on the main optical axis of the 2nd lens plate, from the reason mentioned above, it leads efficiently the outgoing radiation light from each of two or more lamp units to a projection lens, and can realize a bright projection image.

[0032] Moreover, so that it may become the almost same magnitude as the dimension of the configuration projected on a flat surface perpendicular to the main optical axis of the 2nd lens plate obtained when the 2nd lens plate is constituted from two or more small lenses which have the same aspect ratio as the small lens of the 1st lens plate Put in order two or more small lenses which have a small value, and the 2nd lens plate is constituted from a value of the aspect ratio of the small lens of the 1st lens plate. Furthermore, while constituting the 1st lens plate using the small lens and the small lens of the same number which constitute this 2nd lens plate If the reflector of a lamp unit is enlarged so that it may correspond to the dimension of the configuration projected on a flat surface perpendicular to the main optical axis of this 1st lens plate The amount of use of the flux of light by which outgoing radiation is carried out from a light source lamp can be made [more / still], without enlarging the cross-section dimension of the optical system except a reflector compared with the conventional lighting system constituted using the 2nd lens plate which consists of a small lens which has the aspect ratio of the small lens of the 1st lens plate.

[0033] On the contrary, since the dimension of the direction which met in the 2nd direction can be made small in each optical system which the outgoing radiation light from the 2nd lens plate passes in order to obtain the quantity of light equivalent to the outgoing radiation quantity of light to the projection side by the illumination-light bundle which is not compressed using the compressed illumination-light bundle, it is possible to miniaturize the projection mold display with which a lighting system and this lighting system were incorporated.

[0034] Moreover, since the 2nd lighting system of this invention has the integrator optical system constituted by the 1st lens plate, the 2nd lens plate, and the superposition means, it can reduce the illuminance nonuniformity of the illumination light. Moreover, it is possible to have a polarization generating means, to become possible, since only about one kind of polarization flux of light to which the polarization direction was equal can be used as illumination light to use most outgoing beams from a light source lamp, and to raise the use effectiveness of light.

[0035] Moreover, it converges near the 2nd lens plate and the polarization separation means, respectively, and two or more partial flux of lights which carried out outgoing radiation from the 1st lens plate form a secondary light source image. A polarization separation means divides into two kinds of

polarization flux of lights the flux of light which carried out incidence along the 1st direction, and on a polarization separation means, two secondary light source images are located in a line along the 1st direction, and it is formed. Therefore, the magnitude of a polarization separation means is almost equal at least to the magnitude of two secondary light source images located in a line along the 1st direction, and the magnitude of the secondary light source image of the 2nd direction, or its large thing is desirable. here, the magnitude of the 1st direction in each smallness lens of the 2nd lens plate is almost equal to the magnitude of the 1st direction of a polarization separation means -- if it kicks, the 2nd each smallness lens and polarization separation means of a lens plate can be arranged most efficiently, without making a clearance. Therefore, the magnitude of a secondary light source image is approximated with an almost circular image, and the 2nd lens plate can be miniaturized in consideration of the arrangement effectiveness of each smallness lens of the 2nd lens plate, and a polarization separation means, without accompanying the value of the aspect ratio of each smallness lens of the 2nd lens plate by about 1/2, then optical loss. Therefore, [0036] which can use the outgoing radiation light from the light source efficiently, and can obtain the illumination light with much outgoing radiation quantity of light Moreover, although a lamp unit which usually reflects the light emitted from a light source lamp by the reflector, and carries out outgoing radiation as an parallel light is used, the outgoing radiation light from a lamp unit has so bad that it is close to a lamp light shaft the parallelism of outgoing radiation light, and the parallelism of outgoing radiation light is in a good inclination, so that it separates from a lamp light shaft. Therefore, in the secondary light source image formed in the location where the secondary light source image formed of the 2nd lens plate and two or more partial flux of lights near the polarization separation means separated from the core of the 2nd lens plate, the magnitude of an image becomes small. Then, it is desirable to be adjusted so that the magnitude which met in said 2nd direction of each smallness lens which constitutes said each train may become small as two or more trains which met in said 2nd direction of two or more small lenses which constitute said 2nd lens plate separate from said light source to the center position of the flux of light by which outgoing radiation was carried out. Since the width of face of the 2nd direction of a mass of illumination-light bundle which passes such a configuration, then the 2nd lens plate can be compressed still more efficiently, while being able to miniaturize the 2nd lens plate and polarization generating means, the outgoing radiation light from the light source can be used still more efficiently.

[0037] In addition, usage various in respect of the brightness demanded since the brightness of the illumination light can be adjusted to a multistage story if needed, or consumed electric power possible [selection lighting of either] among the light source lamps of two or more of said lamp units then becomes possible.

[0038] Moreover, when making it the wavelength distribution properties of the light by which outgoing radiation is carried out from the light source lamp of two or more of said lamp units differ, respectively, and the tint of the illumination light can be set as a predetermined tint and it applies to a color projection mold display, it is possible to raise the color reproduction nature.

[0039] The lighting system stated above can be used as a source of the illumination light of a projection mold display. That is, it can consider as the configuration which has the 2nd lighting system of this invention which described the projection mold display above, a modulation means to modulate the outgoing radiation light from said lighting system according to image information, and the projection optical system that projects the modulation flux of light acquired with said modulation means on a projection side. As mentioned above, the 2nd lighting system of this invention can use the outgoing radiation light from the light source efficiently, and can obtain the illumination light with much outgoing radiation quantity of light. Therefore, it becomes possible to raise the brightness of a projection image with equipment size almost comparable as the case where a single lamp unit is used, by using the lighting system constituted in this way as a source of the illumination light of a projection mold display.

[0040] In addition, since the 2nd lighting system of this invention is equipped with integrator optical system, even when it has the bias to the optical intensity distribution in the cross section of the flux of

light with the big outgoing beam from a lamp unit, brightness is uniform, since a modulation means can be illuminated by the illumination light without brightness or an irregular color, brightness is uniform over the whole projection side, and a projection image without brightness or an irregular color can be obtained.

[0041] Moreover, the 2nd lighting system of this invention is equipped with a polarization generating means have a polarization separation means and a polarization conversion means, it becomes that it is possible to use most outgoing beams from a light source lamp in the projection mold display equipped with the modulation means using one kind of polarization flux of light like a liquid crystal display since a modulation means can illuminate according to about one kind of polarization flux of light to which the polarization direction is equal, and a very bright projection image can obtain. Moreover, since the polarization flux of light from which the unnecessary polarization direction differs in a display is hardly included in the illumination light, it is few, therefore large simplification of the cooling system which cools a polarizing plate, and the miniaturization of the light absorption in a polarizing plate are attained.

[0042] In order to indicate the color picture by projection, in the above-mentioned configuration In addition, in addition, a color separation means to divide the outgoing radiation light from a lighting system into the colored light bundle of at least 2 colors, Said two or more modulation means to modulate each colored light bundle separated by said color separation means, respectively, What is necessary is to have a color composition means to compound the modulation flux of light of each color after becoming irregular with said each modulation means, and just to consider as the configuration which the synthetic flux of light acquired by this color composition means projects on a projection side through said projection optical system.

[0043]

[Embodiment of the Invention] Below, each example of this invention is explained with reference to a drawing. In addition, in each following example, especially, as long as there is no notice, let for convenience three directions which intersect perpendicularly mutually be X shaft orientations (longitudinal direction), Y shaft orientations (lengthwise direction), and Z shaft orientations (direction parallel to an optical axis).

[0044] (Gestalt of the 1st operation) Drawing 1 is the outline block diagram which looked at superficially the important section of the 1st lighting system of this invention. The lighting system 10 of this example consists of fundamentally the light source section 5 and integrator optical system 3. The outgoing radiation light by which outgoing radiation was carried out from the light source section 5 illuminates the rectangular lighting field 4 as uniform illumination light which does not have illuminance nonuniformity through the integrator optical system 3. The integrator optical system 3 is equipped with the 1st lens plate 31, the 2nd lens plate 32, and the field lens (joint lens) 33.

[0045] The light source section 5 has composition using two lamp units generally used. That is, the light source section 5 is equipped with 1st lamp unit 51A and 2nd lamp unit 51B which have been arranged so that a lamp light shaft may intersect perpendicularly. Each lamp units 51A and 51B are the things of the same dimension with the same configuration, and are equipped with the light source lamps 511A and 511B and Reflectors 512A and 512B. Things, such as a paraboloid form and an ellipsoid form, can be used as reflectors 512A and 512B. Moreover, the light source section 5 is equipped with the synthetic mirror optics system 55 which forms the synthetic flux of light which takes out and compounds an outgoing radiation light part including the lamp light shafts 52 and 53 of the outgoing radiation light from the lamp units 51A and 51B of these pairs, and goes in the direction of system optical-axis 10L of an illumination system (Z shaft orientations).

[0046] The synthetic mirror optics system 55 of this example is equipped with the reflective mirrors 551 and 552 of a pair which reflect the outgoing radiation light from 1st lamp unit 51A in a right angle, and are turned in the direction of system optical-axis 10L. These reflective mirrors 551 and 552 are arranged in the range of the abbreviation 1/4 of the aperture width W of reflector 512A on both sides of the lamp light shaft 52 of 1st lamp unit 51A. about [of the aperture width W of reflector 512B in the

both sides (opening veranda of reflector 512B) to which these reflective mirrors 551 and 552 separated from the lamp light shaft 53 of 2nd lamp unit 51B to coincidence] -- it is arranged in one fourth of range.

[0047] Therefore, it is reflected by the reflective mirrors 551 and 552 of a pair, and the light for the core whose width of face including the lamp light shaft 52 of the outgoing radiation light of 1st lamp unit 51A is Abbreviation 1/2W goes to the integrator optical-system 3 side. the part of outgoing radiation light other than this -- the illumination light -- carrying out -- it is not used. On the other hand, incidence of the light for the core whose width of face including the lamp light shaft 53 of the outgoing radiation light of 2nd lamp unit 51B is Abbreviation 1/2W is carried out to the integrator optical-system 3 side as it is. Since the outgoing radiation light of the part of both sides is interrupted by the reflective mirror 551,552 of a pair, it is not used as illumination light.

[0048] Drawing 2 is the explanatory view showing the quantity of light distribution curve C of the direction which intersects perpendicularly with lamp light shaft 51L in the lamp unit 51 equipped with the paraboloid form reflector. The quantity of light decreases quickly as are shown in this drawing, and there is very much quantity of light of the outgoing radiation light in a part for the core containing lamp light shaft 51L and it separates from lamp light shaft 51L. Therefore, even if it is the case where only the light for the core whose width of face including the lamp light shafts 52 and 53 is Abbreviation 1/2W is used like the lamp units 51A and 51B of this example, most outgoing radiation quantity of lights can be used. Therefore, the lighting system 10 of this example can make the brightness of a lighting field increase to about 1.5 or more times compared with the case where a single lamp unit is used.

[0049] Next, if it explains with reference to drawing 1 again consequently, the synthetic flux of light which the outgoing radiation light part of **** 1/2W containing a part for the core of the outgoing radiation light of both lamp units 51A and 51B is compounded, and is acquired will carry out incidence to the 1st lens plate 31 of the integrator optical system 3.

[0050] Drawing 3 is the outline perspective view showing the 1st lens plate 31. As shown in this drawing, the 1st lens plate 31 has structure which arranged two or more minute rectangle lenses (lens whose appearance configuration in XY flat surface is a rectangle-like) 311 in the shape of a matrix. The appearance configuration on XY flat surface of the rectangle lens 311 is set up so that the configuration and analog of the lighting field 4 may be made. The 2nd lens plate 32 shown in drawing 1 consists of a rectangle lens which constitutes the 1st lens plate 31, and a microlens 321 of the same number.

[0051] With each rectangle lens 311, it dissociates spatially and the light which carried out incidence forms a secondary light source image inside each rectangle lens 321 of the 2nd lens plate 32. That is, the focal location of the rectangle lens 311 is near the inside of the corresponding rectangle lens 321.

[0052] Through the field lens 33 currently stuck on that outgoing radiation side, superposition image formation of two or more secondary light source images formed in the 2nd lens plate 32 is carried out to the lighting field 4, and they illuminate this lighting field 4 to homogeneity mostly. Therefore, incidence of all the outgoing beams from the light source section 5 will be theoretically carried out to the lighting field 4. In addition, if the superposition function of the illumination light is given by using as a decentered lens the microlens 321 which constitutes the 2nd lens plate 32, it is possible to omit the field lens 33.

[0053] Thus, in the lighting system 10 of this example, most outgoing radiation quantity of lights in the lamp units 51A and 51B of a pair are used, incidence is carried out to the integrator optical system 3 as an outgoing beam of width of face W, and the lighting field 4 is illuminated through the integrator optical system 3 that there is almost no illuminance nonuniformity in homogeneity.

[0054] It considers as the unit 56 removable in one carried on the common frame in the light source section 5 of this example here as 1st lamp unit 51A and the reflective mirrors 551 and 552 of a pair showed drawing 1 with a broken line. On the other hand, 2nd lamp unit 51B of another side is being attached and fixed to the frame by the side of the body of a lighting system 10.

[0055] Therefore, in the lighting system 10 of this example, if the unit 56 of 1st lamp unit 51A and the reflective mirrors 551 and 552 of a pair is removed, it will become the configuration equipped with the

light source section equipped with the single light source lamp currently generally used. In this case, since the reflective mirrors 551 and 552 of the pair which had interrupted the both-sides part of the outgoing radiation light of 2nd lamp unit 51B are removed, incidence of the outgoing radiation light of the lamp unit 51B concerned will be carried out to the integrator optical system 3 as it is.

[0056] The thing of a configuration of having had the lamp units 51A and 51B of a pair is used for the lighting system 10 of this example constituted as mentioned above as the light source section 5, and it illuminates using a part with the large outgoing radiation quantity of light of the outgoing radiation light of each lamp unit. Therefore, a lighting field can be illuminated with a high illuminance.

[0057] Moreover, in the lighting system 10 of this example, unitization of the reflective mirrors 551 and 552 of a pair has been carried out to lamp unit 51A, and while the light source section 5 is constituted has made this unit 56 removable to the body of a lighting system. Therefore, since high lighting of the illuminance which used the two lamp unit, and the usual lighting using the usual one lamp unit can be performed alternatively if needed, it is convenient.

[0058] Here, the die length of the optical path of the outgoing radiation light which carries out outgoing radiation from the 1st and 2nd lamp units 51A and 51B, and reaches the lighting field 4 differs between the 1st and 2nd lamp units. Moreover, the die length of the optical path differs with the outgoing radiation light which is reflected by the outgoing radiation light which is reflected by the reflective mirror 551 among the light by which outgoing radiation was carried out from 1st lamp unit 51A, and reaches the lighting field 4, and the reflective mirror 552, and reaches the lighting field 4. However, since the integrator optical system 3 is used in this example, even if a difference arises to the die length of an optical path in this way, the lighting field 4 can be illuminated that there is no nonuniformity in homogeneity.

[0059] In addition, in this example, the light of the width of face of the abbreviation 1/2W including the lamp light shaft of the outgoing radiation light of each lamp unit is used. However, the range of the outgoing radiation light to be used is not limited to Abbreviation 1/2W, and can change the magnitude of the reflective mirror 551,552, for example, can also set it to 7/10W thru/or 3/10W. When it puts in another way into how much breadth is made, it is the thing of the property which should be suitably set up according to distribution of the outgoing radiation quantity of light of the lamp unit to be used etc. whether more incidence of the outgoing radiation light from which lamp unit is carried out to integrator optical system. However, generally, if the reflection loss of the light in the reflective mirror 551,552 is taken into consideration, it is desirable to determine the magnitude of a reflective mirror so that more outgoing radiation light from the lamp unit (it is lamp unit 51B in this example) which carries out not through a reflective mirror and can carry out incidence of the light to direct integrator optical system can be used.

[0060] Moreover, in this example, although the lamp unit of the same magnitude is used with the same configuration, the lamp unit of different magnitude may be used. Moreover, the lamp unit of a different class may be used.

[0061] Furthermore, although the lamp unit equipped with the light source lamp of the same class is used in this example, when using the lamp unit equipped with the light source lamp with which spectrums differ, for example and it applies to a color projection mold display, there is also an advantage of being able to improve the color reproduction nature. Drawing 4 is the explanatory view showing the wavelength distribution property of the illumination light in a lighting system 10. The wavelength distribution property (spectral characteristics) of a lighting system shows various properties according to the class of light source lamp generally used. For example, although it crosses throughout the light and an optical output is obtained, the light source lamp that the output of a red sunset field is insufficient exists. In the wavelength field which shows each colored light as a wavelength distribution property of a lighting system 10 as shown in drawing 4 (C), a relative output presupposes that an almost equal property is desirable. At this time, the wavelength distribution property of lamp unit 51A (light source lamp 511A) presupposes that it is what shows the property that the relative output of a red

sunset field is low, as shown in drawing 4 (A). In such a case, what is necessary is just to choose the lamp used for light source lamp 511B so that the relative output of a red sunset field may become high as a wavelength distribution property of lamp unit 51B as shown in drawing 4 (B). If it does in this way, the illumination light as the lighting-system 10 whole is almost equal to the sum of the lamp units 51A and 51B, and can obtain the illumination light which shows a desired wavelength distribution property as shown in (C). Moreover, it is also possible to obtain the strong illumination light of a red tint and the strong illumination light of a blue tint depending on how to combine a lamp unit. Thus, the illumination light which shows various properties can be obtained by combining the property of the light of two lamp units. In addition, the wavelength distribution property shown in drawing 4 can use the light source lamp which does not pass to an example for explaining the effectiveness of this example, but has other various spectral-distribution properties.

[0062] Moreover, although an illuminance will fall even when one lamp is turned off at the time of use if two lamps are used, there is also an advantage that it can be used continuing as it is.

[0063] Furthermore, a control circuit 50 (drawing 1) is able to consider as the configuration which can turn on both light source lamps alternatively. If it carries out like this, since the brightness of the illumination light can be adjusted to a multistage story if needed, various usage can be done in respect of the brightness demanded or consumed electric power. Drawing 5 is the explanatory view showing the illumination-light generating mode of a lighting system 10. Since the lighting system 10 is equipped with two sources of the illumination light of the lamp units 51A and 51B as mentioned above, as shown in drawing 5 , it can set up four kinds of illumination-light generating modes in the mode 0 to the mode 3. That is, both lamp units 51A and 51B make the mode 0 switch off, and the mode 1 makes lamp unit 51A turn on, and make lamp unit 51B switch off, and the mode 2 makes lamp unit 51A switch off, and makes lamp unit 51B turn on, and the mode 3 is the mode in which both lamp units 51A and 51B are made to turn on. Such lighting modes are switched by the change-over circuit which is not illustrated. The effectiveness that it explains below can be acquired by using it, choosing these four modes.

[0064] Since the lighting field 4 is illuminated by choosing the mode 3 by the illumination light of both lamp units 51A and 51B, the illumination light with optical big reinforcement can be obtained. therefore, the thing for which the reinforcement of the illumination light is increased even if it does not use a not much high power light source lamp for each light source lamp 511A and 511B of the lamp units 51A and 51B — possible — in addition — and the use effectiveness of light can be raised.

[0065] Usually, at the time of use, either the mode 1 or the mode 2 is chosen, and you may make it illuminate the lighting field 4 at it by one of the illumination light of lamp unit 51A or 51B. For example, usually choose the mode 1, only lamp unit 51A is made to turn on, and the lighting field 4 is illuminated by the illumination light. Even when doing in this way and it becomes impossible lamp unit 51A, or to illuminate by the life of the light source lamp 511A etc., by choosing the mode 2, light source lamp 511of lamp unit 51B B can be made to be able to turn on, and it can be used succeedingly. Therefore, it is possible to improve the life of an illumination-light study system.

[0066] Moreover, you may make it a setup which changed the brightness of light source lamp 511A, and the brightness of light source lamp 511B. For example, if light source lamp 511of lamp unit 51A A is usually made into the brightness at the time of use and light source lamp 511of lamp unit 51B B is set as brightness lower than it, the illumination light of the optical reinforcement of a three-stage can be obtained. That is, if the mode 3 is chosen for the illumination light of the usual optical reinforcement by choosing the mode 1 and the mode 2 will be chosen for the illumination light of optical bigger reinforcement, the illumination light with optical, a little small reinforcement can be obtained.

[0067] (Modification of the light source section) Here, various kinds of examples of combination with the modification of the light source section 5, i.e., the arrangement relation of the lamp units 51A and 51B, and the configuration of a synthetic mirror optics system are shown in drawing 6 . In addition, the direction of the drawing Nakaya mark expresses the direction of outgoing radiation of light.

[0068] As shown in this drawing, the arrangement relation of the lamp units 51A and 51B of a pair can

adopt either among the parallel arrangements by the side of [as shown in opposite arrangement as shown in group A-a, group 1-a-g, group 2-a-j, group 3-a-j, group 4-d, and e, g and h, group B-a, rectangular arrangement as shown in b, group 4-a, and b, c and f] the same. Moreover, as it is indicated in group 1-a-g, group 2-a-j, group 3-a-j, group 4-d, and e, g and h as the arrangement whose lamp light shaft of both lamp units corresponds as opposite arrangement as shown in group A-a, both lamp light shafts can adopt either of the arrangement shifted mutually. In addition, the amount of gaps can be changed so that it may understand about a gap of the optical axis of the both sides, if groups 1, 2, 3, and 4 are compared, respectively.

[0069] Two lamp units 51A and 51B like Group B here in the light source section 5 arranged so that each lamp light shaft may cross mutually If that lamp light shaft carries out unitization of lamp unit 51A and the synthetic mirror optics system 55 which are arranged in the location at which the direction of outgoing radiation of the light from the light source section 5 is crossed and makes this unit removable The large lighting of the optical reinforcement which used the two lamp unit, and the usual lighting using the usual one lamp unit can be used alternatively, and it is convenient.

[0070] Moreover, as show to other groups, in the light source section 5 arrange in the location as for which both lamp units 51A and 51B do not carry out a right pair to the direction of outgoing radiation of light, the same effectiveness can be acquire by carry out unitization of the reflective mirror which make only one lamp unit removable or reflect the outgoing radiation light from one lamp unit and this lamp unit, and suppose at coincidence that it be removable. About the unit which consists of a reflective mirror which reflects the outgoing radiation light from one lamp unit and this lamp unit like the latter, when this unit is removed, there are removable, then effectiveness that the equipment with which the light source section was incorporated is lightweight-ized more.

[0071] in addition, when one lamp unit is removed with the configuration of those other than Group B Although it is possible that the quantity of light becomes less than the case where the unit which consists of one lamp unit and two reflective mirrors with Group's B configuration is removed since the light of the part near the opening edge of a reflector is not used As stated previously, the light of the part near the opening edge of a reflector comes out only, and, for a certain reason, does not pose a problem so much.

[0072] As a configuration of the synthetic mirror optics system 55, as while shows Group B, there is a configuration equipped with the reflective mirror which reflects the outgoing radiation light from the lamp unit of the configuration equipped only with the reflective mirror which reflects the outgoing radiation light from a lamp unit, and both sides as show other groups. moreover, as a configuration of the reflective mirrors 551 and 552 As while shows group B-a and b, when the reflective mirror in which the reflective mirror which reflects the outgoing radiation light of a lamp unit reflects the outgoing radiation light of the lamp unit of another side by two sheets is unnecessary, When the reflective mirror which reflects the outgoing radiation light of each lamp unit as shown in group A-a is one sheet at a time, respectively, The reflective mirror which reflects the outgoing radiation light of a lamp unit as while shows group 1-b, c and d, group 2-a-d, etc. by one sheet When there are two reflective mirrors which reflect the outgoing radiation light of the lamp unit of another side, as shown in group 1-e, f, group 2-d-f, etc., either in case the reflective mirror which reflects the outgoing radiation light of each lamp unit is two sheets at a time, respectively can be adopted.

[0073] moreover -- a lamp -- a unit -- 51 -- A -- 51 -- B -- instead of -- using -- not having -- an outgoing beam -- corresponding -- a reflector -- a part -- a side cut -- having given -- a lamp -- a unit -- 51 -- A -- ' -- 51 -- B -- ' -- adopting -- things -- being possible . Drawing 7 is the explanatory view showing an example at the time of constituting lamp unit 51A' to which the side cut was given, and a lighting system as shown in drawing 1 using 51B'. As shown in drawing, in light source section 5', it becomes possible [the part which gave the side cut to the reflector] to move the location of two lamp unit 51A', 51B', and two reflective mirrors 551,552 to a Z direction, and the distance between lamp unit 51A' and the 1st lens plate 31 is shortened. Therefore, while being able to miniaturize

light source section 5' itself, the miniaturization of the equipment with which this light source was incorporated is also attained. Moreover, by giving a side cut to a reflector, it becomes possible lamp unit 51A' and to raise the cooling effectiveness of 51B', and the temperature rise of a lamp unit can be suppressed. In addition, the effectiveness possible adopting the lamp unit to which the side cut was given like the example shown in drawing 7 also in other examples of combination raised to drawing 6 and same as the example shown in drawing 7 can be acquired.

[0074] In addition, although the case shown in drawing 6 where combined and two lamp units have been altogether arranged horizontally (direction parallel to XZ flat surface) in an example is shown in the example, you may make it arrange perpendicularly (direction parallel to YZ flat surface).

[0075] (Gestalt of the 2nd operation) Drawing 8 is the outline block diagram which looked at superficially the important section of the polarization lighting system which applied this invention. The polarization lighting system 60 of this example is equipped with the light source section 5 of the same configuration as the above-mentioned lighting system 10. Moreover, it also has the integrator optical system which consists of two lens plates, i.e., the 1st optical element 71 and condenser lens array 720. In addition, the 1st optical element 71, the condenser lens array 720, and the joint lens 760 have the almost same function as the 1st lens plate 31 of drawing 1 , the 2nd lens plate 32, and the field lens 33. Differing is a point equipped with the polarization optical system for changing into one kind of polarization light to which polarization conversion of the outgoing radiation light with the random polarization direction from the light source section 5 was carried out, and the polarization direction gathered mostly between the condenser lens array 720 and the joint lens 760.

[0076] The polarization lighting system 60 of this example consists of polarization generators 7 fundamentally equipped with the light source section 5 arranged along with system optical-axis 60L, and the function of integrator optical system. The flux of light (it is hereafter called the random polarization flux of light) with the random polarization direction by which outgoing radiation was carried out from the light source section 5 is changed into one kind of polarization flux of light to which the polarization direction was mostly equal with the polarization generator 7, and reaches the lighting field 4. Here, the light source section 5 is arranged so that the optical axis R of the outgoing radiation light of the light source section 5 may be in the condition of having carried out the parallel displacement only of the fixed distance D to X shaft orientations to system optical-axis 60L.

[0077] The polarization generator 7 consists of the 1st optical element 71 and the 2nd optical element 72. The physical relationship of the light source section 5 and the 1st optical element 71 is set up so that the optical axis R of the light source section 5 may be in agreement with the core of the 1st optical element 71. The light which carried out incidence to the 1st optical element 71 is divided into two or more middle flux of lights 712 by the flux of light division lens 711, and forms the secondary light source image 713 of the number of flux of light division lenses, and the same number in the location which the middle flux of light within a flat surface perpendicular to system optical-axis 60L (drawing 8 XY flat surface) converges according to a condensing operation of a flux of light division lens at coincidence. In addition, the appearance configuration on XY flat surface of the flux of light division lens 711 is set up so that the configuration and analog of the lighting field 4 may be made. Since the oblong long lighting field is assumed in the direction of X on XY flat surface in this example, the appearance configuration on XY flat surface of the flux of light division lens 711 is also oblong.

[0078] The 2nd optical element 72 is complex by which a profile configuration is carried out from the condenser lens array 720, a gobo 730, the polarization separation unit array 740, the selection phase contrast plate 750, and the joint lens 760. The 2nd optical element 72 of this configuration is arranged in a perpendicular flat surface (XY flat surface of drawing) to system optical-axis 60L near the location in which the secondary light source image 713 by the 1st optical element 71 is formed. After this 2nd optical element 72 divides each of the middle flux of light 712 into P polarization flux of light and S polarization flux of light spatially, it arranges the polarization direction of one polarization flux of light in the polarization direction of the polarization flux of light of another side, and has the function to lead

each flux of light to which the polarization direction was mostly equal to one lighting field 4.
[0079] The condenser lens array 720 has the function drawn while condensing each middle flux of light in the specific location of the polarization separation unit array 740. As for the lens property of the flux of light division lens 711 of the 1st optical element 71, and the condenser lens 721 of the condenser lens array 720, it is desirable to optimize respectively in consideration of a point with ideal the inclination of the chief ray of the light which carries out incidence to the polarization separation unit array 740 being parallel to system optical-axis 60L.
[0080] However, generally in consideration of the ease of low-cost-izing of optical system, and a design, the condenser lens array 720 may be constituted using the flux of light division lens 711 and the condenser lens whose configuration in XY flat surface is an analog, using the completely same thing as the 1st optical element 71 as a condenser lens array 720. In this example, the same thing as the 1st optical element 71 is used as a condenser lens array 720. In addition, the condenser lens array 720 may be arranged in the location (side near the 1st optical element 71) distant from the gobo 730 or the polarization separation unit array 740.
[0081] The appearance of a gobo 730 is shown in drawing 9 . As shown in this drawing, two or more face shields 731 and two or more effective areas 732 arrange a gobo 730 in the shape of a stripe, and it is constituted. The method of the array of this face shield 731 and an effective area 732 is equivalent to the method of the array of the polarization separation side 741 of the polarization separation unit array 740 mentioned later. The flux of light which carried out incidence to the face shield 731 of a gobo 730 is interrupted, and the flux of light which carried out incidence to the effective area 732 passes a gobo 730 as it is. Therefore, the gobo 730 has the function which controls the flux of light penetrated according to the location on a gobo 730, and the method of the array of a face shield 731 and an effective area 732 is set up so that it may be formed only on the polarization separation side 741 of the polarization separation unit array 740 which the secondary light source image 713 by the 1st optical element 71 mentions later. what formed partially the film (for example, the chromium film, aluminum film, and dielectric multilayers) of protection-from-light nature in the plate-like transparent body (for example, glass plate) like this example as a gobo 730 — or — for example, what prepared opening can be used for the plate of protection-from-light nature like an aluminum plate. In forming a face shield especially using the film of protection-from-light nature, it can demonstrate the same function, even if it forms the film of protection-from-light nature directly on the condenser lens array 720 or the polarization separation unit array 740 mentioned later.
[0082] Drawing 10 is the perspective view showing the appearance of the polarization separation unit array 740. As shown in this drawing, the polarization separation unit array 740 is carrying out the configuration which arranged two or more polarization separation units 770 in the shape of a matrix. The method of the array of the polarization separation unit 770 is equivalent to the lens property of the flux of light division lens 711 which constitutes the 1st optical element 71, and the method of those arrays. In this example, since the 1st optical element 71 is constituted from arranging those flux of light division lenses in the shape of a rectangular matrix using the flux of light division lens 711 of this cardiac system which has the same configuration altogether, when the polarization separation unit array 740 also arranges the polarization separation unit 770 of the same configuration in the shape of a rectangular matrix to the same direction altogether, it is constituted. In addition, two or more long and slender polarization separation units are prepared in the direction of Y which has the same height H as the polarization separation unit array 740 when all the polarization separation units of a **** same train are the same configurations in the direction of Y, and if a polarization separation unit array is produced by arranging these long and slender polarization separation units in the direction of X, and sticking, the display flatness of the interface of the direction of X of long and slender polarization separation units can raise. Thus, while the direction which used the produced polarization separation unit array can reduce the optical loss in the interface between polarization separation units, it is advantageous at the point that the manufacturing cost of a polarization separation unit array can be reduced.

[0083] Drawing 11 is the explanatory view showing the appearance of the polarization separation unit 770, and its function. As shown in this drawing, the polarization separation unit 770 is the structure of the shape of the square pole which equipped the interior with the polarization separation side 741 and the reflector 742, and has the function to divide spatially into P polarization flux of light and S polarization flux of light each of the middle flux of light which carries out incidence to a polarization separation unit. The appearance configuration on XY flat surface of the polarization separation unit 770 is making the appearance configuration and analog on XY flat surface of the flux of light division lens 711, namely, has the shape of an oblong rectangle. The polarization separation side 741 and the reflector 742 are arranged so that it may rank with the longitudinal direction of the appearance configuration of the polarization separation unit 770, i.e., a longitudinal direction, (the direction of X). Here, the polarization separation side 741 is making the condition with nothing and a reflector 742 parallel to a polarization separation side for the inclination of about 45 degrees to the system optical axis L. Furthermore, the area (equal to the area of P outgoing radiation side 743 mentioned later) which projected the polarization separation side 741 on XY flat surface, and the area (equal to the area of S outgoing radiation side 744 mentioned later) which projected the reflector 742 on XY flat surface are equal. Furthermore, the breadth Wp on XY flat surface of the field where the polarization separation side 741 exists, and the breadth Wm on XY flat surface of the field where a reflector 742 exists are set up so that it may become equal and each may become half [of the breadth Wl on XY flat surface of a polarization separation unit]. In addition, generally, the polarization separation sides 741 are dielectric multilayers, and can form a reflector 742 by dielectric multilayers or the aluminum film.

[0084] The light which carried out incidence to the polarization separation unit 770 is divided into P polarization flux of light 745 which passes through the polarization separation side 741, without changing a travelling direction, and S polarization flux of light 746 which changes a travelling direction in the direction of the reflector 742 which is reflected in respect of [741] polarization separation, and adjoins in the polarization separation side 741. Outgoing radiation of the P polarization flux of light 745 is carried out from the polarization separation unit 770 through P outgoing radiation side 743 as it is, S polarization flux of light 746 changes a travelling direction again in a reflector 742, will be in a condition almost parallel to P polarization flux of light 745, and outgoing radiation will be carried out from the polarization separation unit 770 through S outgoing radiation side 744. Therefore, it separates into two kinds of polarization flux of lights, P polarization flux of light 745 and S polarization flux of light 746, from which the polarization direction differs, and outgoing radiation of the random polarization flux of light which carried out incidence to the polarization separation unit 770 is carried out towards the almost same direction from the location (P outgoing radiation side 743 and S outgoing radiation side 744) where the polarization separation units 770 differ.

[0085] Again, it explains based on drawing 8 . The middle flux of light 712 by which incidence is carried out to each polarization separation unit 770 needs to be led to the field to which the polarization separation side 741 exists. Therefore, the physical relationship of each polarization separation unit 770 and each condenser lens 721 and the lens property of each condenser lens 721 are set up so that the middle flux of light 712 may form a secondary light source image near the center section of the polarization separation side 741. Especially, in this example, in order to arrange so that the medial axis of each condenser lens may come to the center section of the polarization separation side 741 in each polarization separation unit 770, the condenser lens array 720 is arranged where only the distance D equivalent to one fourth of the breadth Wl of a polarization separation unit is shifted in the direction of X to the polarization separation unit array 740.

[0086] A gobo 730 does as the polarization separation unit array 740 and the condenser lens array 720, it is arranged so that the core of each effective area 732 of a gobo 730 and the core of the polarization separation side 741 of each polarization separation unit 770 may be mostly in agreement, and the opening breadth (aperture width of the direction of X) of an effective area 732 is set as the magnitude of the abbreviation one half of the breadth Wl of the polarization separation unit 770. consequently, the

flux of light which hardly existed since the middle flux of light which carries out not through the polarization separation side 741, and carries out direct incidence to a reflector 742 was beforehand interrupted by the face shield 731 of a gobo 730, but passed the effective area 732 of a gobo 730 — the — all will carry out incidence of almost only to the polarization separation side 741. Therefore, by installation of a gobo 730, in a polarization separation unit, incidence will be carried out to the direct reflector 742, and the flux of light which carries out incidence will not almost exist in the polarization separation side 741 which adjoins through a reflector 742.

[0087] The selection phase contrast plate 750 with which lambda / 2 phase-contrast plate 751 has been arranged regularly is installed in the outgoing radiation side side of the polarization separation unit array 740. That is, lambda / 2 phase-contrast plate 751 is arranged only at the part of P outgoing radiation side 743 (drawing 11) of the polarization separation unit 770, and lambda / 2 phase-contrast plate 751 is not installed in the part of S outgoing radiation side 744. According to such an arrangement condition of lambda / 2 phase-contrast plate 751, in case P polarization flux of light by which outgoing radiation was carried out from the polarization separation unit 770 passes lambda / 2 phase-contrast plate 751, it receives a rotation operation of the polarization direction and is changed into S polarization flux of light. On the other hand, since S polarization flux of light by which outgoing radiation was carried out from S outgoing radiation side 744 does not pass lambda / 2 phase-contrast plate 751, the polarization direction does not change but passes the selection phase contrast plate 750 with S polarization flux of light. When the above is summarized, it means that the middle flux of light with the random polarization direction had been changed into one kind of polarization flux of light (in this case, S polarization flux of light) by the polarization separation unit array 740 and the selection phase contrast plate 750.

[0088] The flux of light which the joint lens 760 is arranged and was arranged with S polarization flux of light with the selection phase contrast plate 750 is led to the lighting field 4 with the joint lens 760, and is superimposed on a lighting field at the outgoing radiation side side of the selection phase contrast plate 750. Here, the joint lens 760 does not need to be one independent lens object, and may be the aggregate of two or more lenses like the 1st optical element 71.

[0089] When the function of the 2nd optical element 72 is summarized, the middle flux of light 712 (that is, image side started with the flux of light division lens 711) divided by the 1st optical element 71 is superimposed by the 2nd optical element 72 on the lighting field 4. It can come, simultaneously the middle flux of light which is the random polarization flux of light is spatially divided into two kinds of polarization flux of lights from which the polarization direction differs by the intermediate polarization separation unit array 740, and it is changed into about one kind of polarization flux of light in case the selection phase contrast plate 750 is passed. Here, a gobo 730 is arranged at the incidence side of the polarization separation unit array 740, since it has composition in which the middle flux of light carries out incidence only to the polarization separation side 741 of the polarization separation unit 770, there is almost no middle flux of light which carries out incidence to the polarization separation side 741 through a reflector 742, and the class of polarization flux of light by which outgoing radiation is carried out from the polarization separation unit array 770 is limited to about one kind. Therefore, the lighting field 4 will almost be mostly illuminated by homogeneity by one kind of polarization flux of light.

[0090] As mentioned above, the magnitude of the secondary light source image 712 formed of the 1st optical element 71 is influenced by the parallelism of the flux of light (flux of light by which outgoing radiation is carried out from the light source when a lighting system is assumed) which carries out incidence to the 1st optical element. Since only a secondary light source image with a big dimension can be formed when parallelism is bad, the middle flux of light which carries out not through the polarization separation side of a polarization separation unit, and carries out direct incidence to a reflector exists mostly, and the phenomenon which other polarization flux of lights from which the polarization direction differs mix to an illumination-light bundle cannot be avoided. Since the polarization lighting system 60 of drawing 8 has the gobo 730, when it constitutes a polarization lighting system using the light source

which carries out outgoing radiation of the bad flux of light of parallelism, the especially excellent effectiveness is demonstrated.

[0091] In addition, it is possible to omit the condenser lens array 720 possible [omitting a gobo 730], when most middle flux of lights can carry out direct incidence to the polarization separation side 741 (that is, there is little middle flux of light which carries out direct incidence to a reflector 742), when the parallelism of the outgoing beam from the light source section is high.

[0092] As explained above, according to the polarization lighting system 60 of this example, the same effectiveness as the lighting system 10 mentioned above can be acquired.

[0093] In addition, the following effectiveness can be acquired in the polarization lighting system 60 of this example. That is, while changing into about one kind of polarization flux of light the random polarization flux of light by which outgoing radiation was carried out from the light source section 5 with the polarization generator 7 constituted by the 1st optical element 71 and 2nd optical element 72, it has the effectiveness that the lighting field 4 can be illuminated to homogeneity according to the flux of light to which the polarization direction was equal. Moreover, since it is hardly accompanied by optical loss in the generating process of the polarization flux of light, all can almost be led to the lighting field 4, therefore it has the description of the light by which outgoing radiation is carried out from the light source section that the use effectiveness of light is very high. Furthermore, since the gobo 730 is arranged in the 2nd optical element 72, in the polarization flux of light which illuminates the lighting field 4, other polarization flux of lights from which the polarization direction differs hardly blend. Therefore, when the polarization lighting system of this invention is used as equipment which illuminates the modulation means which displays using the polarization flux of light like liquid crystal equipment, the illumination light of a modulation means may be able to do conventionally the polarizing plate arranged at the side which carries out incidence as it is unnecessary. moreover, since there are very few amounts of light absorption in a polarizing plate even when it is alike as usual and you need a polarizing plate, a cooling system required to suppress generation of heat of a polarizing plate and a modulation means can be miniaturized sharply.

[0094] In addition, in this example, the condenser lens array 720 which constitutes the 2nd optical element 72, the gobo 730, the polarization separation unit array 740, the selection phase contrast plate 750, and the joint lens 760 are unified optically, the optical loss generated in those interfaces by this is reduced, and the effectiveness which raises efficiency for light utilization further is acquired. Here, it means that each ["which is unified optically"] optical element has stuck mutually. It can unify optically by sticking two or more optical elements with adhesives, or really fabricating.

[0095] Furthermore, it is considering as the gestalt which divides into a longitudinal direction (the direction of X) two kinds of polarization flux of lights by which make an oblong configuration the flux of light division lens 711 which constitutes the 1st optical element 71 according to the configuration of the lighting field 4 which is an oblong rectangle configuration, and outgoing radiation is carried out to coincidence from the polarization separation unit array 740. For this reason, lighting effectiveness (efficiency for light utilization) can be raised, without making the quantity of light useless, even when illuminating the lighting field 4 which has an oblong rectangle configuration.

[0096] Generally, if the flux of light with the random polarization direction is simply divided into P polarization flux of light and S polarization flux of light, the width of face of the whole flux of light after separation will spread twice, and will also enlarge optical system according to it. However, since the breadth to the longitudinal direction of the path of the flux of light which originates in separating into the two polarization flux of lights by forming two or more minute secondary light source images 713 by the 1st optical element 71, and arranging a reflector 742 in the polarization lighting system of this invention to the space where those secondary light source images do not exist, and is produced is absorbed, the width of face of the whole flux of light hardly spreads, but has the description that small optical system is realizable.

[0097] (Gestalt of the 3rd operation) Next, an example of the polarization lighting system 60 of the

above-mentioned configuration and the display of the projection mold with which polarization lighting-system 60A of the same configuration was incorporated fundamentally is explained. In addition, in this example, the liquid crystal equipment of a transparency mold is used as a modulation means to modulate the outgoing beam from a polarization lighting system based on display information.

[0098] Drawing 12 is the outline block diagram having shown the important section of the optical system of the projection mold display 80 by this invention, and shows the configuration in XZ flat surface. The color separation optical system 400 from which the projection mold display 80 of this example separates polarization lighting-system 60A and a white light bundle into the colored light of three colors, The liquid crystal equipments 411, 412, and 413 of the transparency mold of three sheets which modulates each colored light based on display information, and forms a display image, The profile configuration is carried out from the cross dichroic prism 450 as a color composition means to compound the colored light of three colors and to form a color picture, and the projection lens 460 as projection optical system which indicates the color picture by projection.

[0099] Polarization lighting-system 60A has the light source section 5 equipped with the lamp units 51A and 51B of the pair which carries out outgoing radiation of the random polarization flux of light to an one direction, and the random polarization flux of light by which outgoing radiation was carried out is changed into about one kind of polarization flux of light from this light source section 5 by the polarization generator 7. In polarization lighting-system 60A of this example, it arranges so that the optical axis of the 1st optical element 71 which constitutes the polarization generator 7, and the 2nd optical element 72 may intersect perpendicularly mutually, and the reflective mirror 73 made to incline 45 degrees to each among these is arranged. The configuration of those other than this is the same as that of the above-mentioned polarization lighting system 60, and is omitted about the detailed explanation.

[0100] First, in the blue light green light reflex dichroic mirror 401 of the color separation optical system 400, red light penetrates the flux of light by which outgoing radiation was carried out from this polarization lighting-system 60A, and blue glow and green light reflect it. It is reflected by the reflective mirror 403 and red light reaches the liquid crystal equipment 411 for red sunset through the field lens 415. On the other hand, among blue glow and green light, it is reflected by the green light reflex dichroic mirror 402 of the color separation optical system 400, and green light reaches the liquid crystal equipment 412 for **** through the field lens 416. In addition, the field lenses 415 and 416 have the function changed so that the flux of light which carried out incidence may turn into the flux of light parallel to the medial axis.

[0101] Here, since the die length of the optical path of blue glow is longer than the die length of the optical path of other 2 colored light, to blue glow, the light guide optical system 430 containing the relay lens system which consists of the incidence lens 431, a relay lens 432, and an outgoing radiation lens 433 has been established. That is, after being reflected by the reflective mirror 435 through the incidence lens 431, leading it to a relay lens 432 first, after blue glow penetrated the green light reflex dichroic mirror 402, and converging on this relay lens, by the reflective mirror 436, it is led to the outgoing radiation lens 433, and reaches the liquid crystal equipment 413 for blue lights after that. In addition, the outgoing radiation lens 433 has the same function as the field lenses 415 and 416.

[0102] After three liquid crystal equipments 411, 412, and 413 modulate each colored light and include the image information corresponding to each colored light, they are the liquid crystal panels (called a "liquid crystal light valve") of the transparency mold which carries out incidence of the modulated colored light to the cross dichroic prism 450. It is formed in the shape of a cross joint, and the dielectric multilayers of red sunset reflection and the dielectric multilayers of blue light reflection compound each modulation flux of light in the cross dichroic prism 450, and form a color picture in it. Expansion projection will be carried out on a screen 470 with the projection lens 460, and the color picture formed here will form a projection image.

[0103] Thus, in the constituted projection mold display 80, since polarization lighting-system 60A

equipped with the two lamp units 51A and 51B is adopted as a polarization lighting system, a bright projection image can be formed.

[0104] Moreover, since it can do [make / only one lamp unit / turn on etc.] as a drive circuit of polarization lighting-system 60A when you do not need an illuminance so much if the circuit which can carry out the lighting drive of these alternatively is used while being able to carry out the lighting drive of both lamp units 51A and 51B at coincidence, the projection image of the optimal brightness according to an operating environment can be formed.

[0105] Furthermore, in polarization lighting-system 60A, let these be units 56 so that you can detach and attach lamp unit 51A and the reflective mirrors 551 and 552 by one. Therefore, if it removes this unit 56 in carrying the projection mold display 80, that part and equipment weight will be reduced. It is desirable to consider each of the ballast circuit part of each lamp units 51A and 51B as another configuration, to also carry the near ballast circuit part of removable lamp unit 51A in a unit 56 about this point, and to enable it to detach and attach in one. Since the size of equipment can also be miniaturized while being able to reduce the equipment weight when removing a unit 56 sharply, if it does in this way, it becomes convenient to carry.

[0106] In addition, in the projection mold display 80 of this example, the liquid crystal equipment of the type which modulates one kind of polarization flux of light is used. Therefore, when the random polarization flux of light was led to liquid crystal equipment using the conventional lighting system, the light of the abbreviation one half of the random polarization flux of lights had the trouble of suppressing generation of heat of a polarizing plate and that it was large-sized and a cooling system with the big noise was required while the use effectiveness of light was bad, since it was absorbed with the polarizing plate (not shown) and changed to heat. However, in the projection mold display 80 of this example, this trouble is improved sharply.

[0107] That is, in the projection mold display 80 of this example, it considers as the condition that the polarization direction was equal, one polarization flux of light, for example, S polarization flux of light, in polarization lighting-system 60A. So, since about one kind of polarization flux of light to which the polarization direction was equal is led to three liquid crystal equipments 411, 412, and 413, there can be very little light absorption by the polarizing plate, therefore its use effectiveness of light can improve, and it can obtain a bright projection image.

[0108] In polarization lighting-system 60A currently especially used as a lighting system, since the gobo 730 is arranged inside the 2nd optical element 72, other unnecessary polarization flux of lights hardly mix at a display with liquid crystal equipment into the illumination light by which outgoing radiation is carried out from polarization lighting-system 60A. Consequently, there are very few amounts of light absorption in the polarizing plate (not shown) arranged at the side in which the light of three liquid crystal equipments 411, 412, and 413 carries out incidence, respectively, and since the calorific value by light absorption also decreases extremely, the cooling system for controlling the temperature rise of a polarizing plate or liquid crystal equipment can be miniaturized sharply.

[0109] From the above thing, also when it is going to realize the projection mold display which can display a very bright projection image using a light source lamp with a very big optical output, it can respond with a small cooling system, therefore the noise of a cooling system can also be made low, and a quiet and highly efficient projection mold display can be realized.

[0110] Furthermore, in polarization lighting-system 60A, two kinds of polarization flux of lights are spatially divided into the longitudinal direction (the direction of X) in the 2nd optical element 72. Therefore, it is convenient for illuminating the liquid crystal equipment which did not make the quantity of light useless and carried out the oblong rectangle configuration.

[0111] By polarization lighting-system 60A of this example, as mentioned above, in spite of having incorporated the polarization conversion optical element, the broadening of the flux of light which carries out outgoing radiation of the polarization separation unit array 740 is stopped further again. In case this illuminates liquid crystal equipment, it means that there is almost no light which carries out incidence to

liquid crystal equipment with a big include angle. therefore, the f number is small -- even if it does not use the projection lens system of the diameter of macrostomia extremely, a bright projection image can be realized, consequently a small projection mold display can be realized.

[0112] Moreover, since the cross dichroic prism 450 is used as a color composition means in this example, the miniaturization of equipment is possible. Moreover, since the die length of the optical path between the liquid crystal equipments 411, 412, and 413 and the projection lens 460 is short, even if it uses the projection lens system of comparatively small aperture, a bright projection image is realizable. Moreover, since each colored light has established the light guide optical system 430 in which only one optical path of the three optical paths contains the relay lens system which the die length of an optical path becomes from the incidence lens 431, a relay lens 432, and the outgoing radiation lens 433 to the longest blue glow in this example although the die length of the optical path differs, an irregular color etc. does not arise.

[0113] In addition, the mirror optics system using the dichroic mirror of two sheets as a color composition means can also constitute a projection mold display. Of course, the bright high-definition projection image excellent in the use effectiveness of light can be formed like [it is possible to incorporate the polarization lighting system of this example also in such a case, and] the case where it is this example.

[0114] Moreover, although considered as the configuration which acquires S polarization flux of light from the random polarization flux of light as one kind of polarization flux of light in this example, of course, it is good also as a configuration which acquires P polarization flux of light.

[0115] (Modification of a lamp unit) The modification of the above-mentioned lamp units 51A and 51B is shown in drawing 13 and drawing 14 . In addition, drawing 14 is drawing having shown the cross section in XZ flat surface including the lamp light shaft 54 of lamp unit 51C shown in drawing 13 . As shown in these drawings, the fundamental configuration of lamp unit 51C of this example is the same as that of the lamp units 51A and 51B mentioned above, and consists of light source lamp 511C and reflector 512C. However, in lamp unit 51C of this example, the part of the both sides of X shaft orientations is closed by the reflective mirrors 513 and 514 of a pair among the circular openings 515 of the reflector 512C, and let aperture width of X shaft orientations including the lamp light shaft 54 be Abbreviation 1/2W. The reflectors 513a and 514a of the reflective mirrors 513 and 514 are formed in the reflector side of reflector 512C.

[0116] Thus, in constituted lamp unit 51C, as shown in drawing 14 , outgoing radiation of the outgoing radiation light for a core with much quantity of light is carried out, without being interrupted as it is. However, the part of the outgoing radiation light of a both-sides part is reflected by the reflective mirrors 513 and 514. Again, it is reflected in the reflector 516 of reflector 512C, and outgoing radiation of the reflected light is carried out, without being interrupted by the reflective mirrors 513 and 514 through the lamp core side near the lamp light shaft 54.

[0117] When it is used instead of the lamp units 51A and 51B which mentioned above lamp unit 51C of this configuration, the outgoing radiation light from a both-sides part which is separated from the lamp light shaft which was not interrupted and used by the synthetic mirror optics system 55 (refer to drawing 1 , drawing 6 , and drawing 8) till then can be returned to a reflector side by the reflective mirrors 513 and 514, and can be reused. Therefore, the amount of outgoing beams from the part and a lamp unit can be made to increase.

[0118] (Gestalt of the 4th operation) Drawing 15 is drawing explaining the array relation of the dichroic mirror and each lamp unit in the projection mold display using the lighting system of still more nearly another configuration of having applied this invention. Signs that the red flux of light divided into drawing 15 (A) and (B) with the blue light green light reflex dichroic mirror 401 which is a colored light separation optical element among the outgoing beams from a lighting system 100 illuminates the liquid crystal equipment 411 for red sunset are shown typically. In addition, although only the cross dichroic prism 450, the liquid crystal equipment 411 for red sunset, the blue light green light reflex dichroic mirror 401, and a

lighting system 100 are taken out to drawing 15 (A) and (B) and these optical elements are shown in the shape of a straight line for convenience, a different part from the projection mold display 80 shown in drawing 12 is the point of having changed polarization lighting-system 60A into the lighting system 100 of this example to the last.

[0119] As shown in drawing 15 (A) and (B), the blue light green light reflex dichroic mirror 401 which is a separation optical element is arranged so that a predetermined include angle may be accomplished to YZ flat surface and XY flat surface to an abbreviation perpendicular to the inside of XZ flat surface.

[0120] The lighting system 100 of this example had the light source section 110, and the light source section 110 is mostly equipped with the 1st of the same dimension, and the 2nd lamp unit 110A and 110B with the same configuration. Each lamp units 110A and 110B consist of reflectors 130A and 130B which considered the paraboloid form, the ellipse form, the round shape, etc. as the light source lamps 120A and 120B. In accordance with about Y shaft orientations, opposite arrangement arrangement of each lamp units 110A and 110B is carried out. Namely, it is separated by the dichroic mirror 401 and each lamp units 110A and 110B are arranged in the direction which intersects perpendicularly to the direction of two outgoing radiation light by which outgoing radiation is carried out from there. And it is reflected by the reflective mirrors 140A and 140B, and outgoing radiation of the outgoing radiation light from each lamp units 110A and 110B is carried out to the direction of a dichroic mirror 401. This lighting system 100 is [0121] which the example by group A-a shown in drawing 6 is shown, and is one of the modifications of the 1st lighting system 10. Drawing 17 is the explanatory view showing the color separation property of the blue light green light reflex dichroic mirror 401. As a continuous line shows to this drawing, if light carries out incidence of the blue light green light reflex dichroic mirror 401 at an angle of predetermined, it will penetrate only a part for red Mitsunari of that light (about 600nm or more), and will reflect parts for other Mitsunari (a part for a blue light component and green Mitsunari). Such a color separation property will change according to the incident angle, if the incident angle of the light to the blue light green light reflex dichroic mirror 401 shifts. For this reason, if incidence of the light is not carried out to the blue light green light reflex dichroic mirror 401 by the predetermined incident angle, the color of the red light led to the liquid crystal equipment 411 for red sunset will change.

[0122] Drawing 16 is the explanatory view showing the arrangement relation between each lamp unit when X shaft orientations are countered and each lamp units 110A and 110B have been arranged, and a dichroic mirror. The incident angle thetaA1 of the outgoing radiation light from each lamp units 110A and 110B to the blue light green light reflex dichroic mirror 401 and thetaB1 if each lamp units 110A and 110B are arranged in accordance with X shaft orientations as shown in this drawing While differing mutually between lamp unit 110A and 110B, it will shift from the above-mentioned predetermined include angle. For this reason, to the outgoing radiation light from lamp unit 110A, it becomes a color separation property as shown in drawing 17 by the dotted line, for example, and a desired color separation property as shown in drawing 17 as the continuous line is no longer acquired. Moreover, it becomes a color separation property as shown in drawing 17 with an alternate long and short dash line also to the outgoing radiation light from lamp unit 110B, and a desired color separation property is no longer acquired similarly. That is, the color separation properties over each outgoing radiation light will differ mutually. Consequently, a color gap will arise in the red light which penetrates a dichroic mirror 401 and is led to the liquid crystal equipment for red sunset 411.

[0123] On the other hand, in the lighting system 100 of this example, since opposite arrangement of each lamp units 110A and 110B has been carried out in accordance with about Y shaft orientations as shown in drawing 15 (A) and (B), incidence of the outgoing radiation light from each lamp units 110A and 110B can both be carried out according to an equal incident angle to the blue light green light reflex dichroic mirror 401. For this reason, while being able to make equal the color separation property over each outgoing radiation light, a desired color separation property can be acquired. Therefore, a color gap of the red light which illuminates the liquid crystal equipment 411 for red sunset can be reduced.

[0124] In addition, since incidence of the outgoing radiation light from each lamp units 110A and 110B

can both be carried out by the equal incident angle theta like the blue light green light reflex dichroic mirror 401 also to the **** dichroic mirror 402, a color gap of the illumination light of the liquid crystal equipment 412 for **** and the liquid crystal equipment 413 for blue lights can be reduced. Therefore, the lighting system 100 of this example has uniform brightness, and can illuminate the illumination light without a color gap to liquid crystal equipment.

[0125] Furthermore, having mentioned above is same also about the red sunset reflective die clo IKKU side 451 of a dichroic prism 450, and the blue light reflective die clo IKKU side 452, as shown in drawing 15 (A) and (B). Namely, the include angle thetaA2 of the outgoing radiation light from each lamp units 110A and 110B which carry out incidence to the die clo IKKU sides 451 and 452 and thetaB-2 A comrade also becomes equal. Therefore, if the lighting system 100 of this example is built into a projection mold display, a color gap of a projection image can also be reduced.

[0126] Moreover, in the lighting system 100 of this example, since it has two lamp units like the gestalt of operation mentioned above, the illuminance as the whole lighting system is also raised.

[0127] From the above thing, if the lighting system 100 of this example is built into a projection mold display, it is brightly uniform over the whole projection side, and the projection mold display with which a projection image without a color gap is obtained can be realized.

[0128] Moreover, even if it adds further integrator optical system and a polarization generator which were mentioned above to the lighting system 100 of this example, it is easy to be natural, and in this case, as mentioned above, the effectiveness by using integrator optical system and the effectiveness by using a polarization generator can be added to the above-mentioned effectiveness, and can be acquired. That is, in addition to reduction of a color gap of a projection image, reduction of the improvement in brightness, illuminance unevenness, or an irregular color is realizable.

[0129] Furthermore, also in the lighting system 100 of this example, if both light source lamps are considered as the configuration which can be turned on alternatively, since the brightness of the illumination light can be adjusted to a multistage story if needed, various usage can be done in respect of the brightness demanded or consumed electric power. Although brightness is especially reduced according to the lighting system 100 of this example since the spectral characteristic of a dichroic mirror or prism does not change even when one lamp is used, it is advantageous to a color tone at the point that a changeless projection image is obtained. Moreover, when using the lamp unit equipped with the light source lamp with which spectrums differ and it applies to a color projection mold display, there is also an advantage of being able to improve the color reproduction nature.

[0130] In addition, although this example explains the case where the lighting system 100 which carried out opposite arrangement of the two lamp units in the direction of y is applied to a projection mold display to the example, it is not limited to this. When three directional axes which intersect perpendicularly mutually in short are set to X, Y, and Z and a direction parallel to the optical axis of the outgoing radiation light from a lighting system is set to Z, The color separation side of a dichroic mirror, and the die clo IKKU side of a cross dichroic prism It is arranged so that a predetermined include angle may be accomplished to YZ flat surface and XY flat surface to an abbreviation perpendicular to XZ flat surface, and two or more lamp units and said synthetic mirror means should just be arranged so that the outgoing radiation light from two or more lamp units may be compounded along the direction of abbreviation Y.

[0131] (Gestalt of the 5th operation) Drawing 18 shows the outline block diagram of the polarization lighting system of still more nearly another configuration of having applied this invention. The polarization lighting system 90 of this example is equipped with the light source section 5 and polarization generator 7' like the polarization lighting system 60 (drawing 8). However, lamp unit 51B is arranged at the sense whose lamp light shaft 51BL corresponds with system optical-axis 90L mostly, and lamp unit 51A has lamp light shaft 51BL almost parallel to Y shaft orientations, and it is arranged so that the opening may turn to a lower part. Polarization generator 7' has the function which both illuminates the lighting field 4 to homogeneity mostly according to the flux of light which changes into

about one kind of polarization flux of light the random polarization flux of light by which outgoing radiation was carried out from the light source section 5 like the polarization generator 7 (drawing 8), and to which the polarization direction was equal.

[0132] 1st optical element 71' which constitutes polarization generator 7' is the lens array which arranged flux of light division lens 711' in the shape of [of four line four trains] a matrix like the 1st optical element 71 shown in drawing 8 . however — the flux of light — division — a lens — 711 — ' — the — Y — a direction — a location — responding — the flux of light — division — a lens — 711 — a — ' — 711 — b — ' — 711 — c — ' — 711 — d — ' — four — a kind — a rectangle — a lens — using — having — **** . each — the flux of light — division — a lens — 711 — a — ' — 711 — b — ' — 711 — c — ' — 711 — d — ' — mentioning later — as — each — a lens — from — outgoing radiation — having carried out — the flux of light — Y — a direction — deviating — making — as — forming — having had — a decentered lens — it is .

[0133] the — two — an optical element — 72 — ' — the — two — an optical element — 72 (drawing 8) — the same — a condenser lens — an array — 720 — ' — a gobo — 730 — ' — polarization — separation — a unit — an array — 740 — ' — selection — phase contrast — a plate — 750 — ' — and — association — a lens — 760 — ' — having — **** . Condenser lens array 720' has the configuration which arranged condenser lens 721' in four-line four trains like the condenser lens array 720 (drawing 8) so that it might correspond to 1st optical element 71'. a condenser lens — 721 — ' — the flux of light — division — a lens — 711 — ' — the same — the — Y — a direction — a location — having responded — eccentricity — having — a condenser lens — 721 — a — ' — 721 — b — ' — 721 — c — ' — 721 — d — ' — a rectangle — a lens — using — having — **** . However, condenser lens 721' has the small magnitude of the direction of Y compared with flux of light division lens 711', and, also in condenser lens array 720', the magnitude of the direction of Y is small compared with 1st optical element 71'.

[0134] Polarization separation unit array 740' arranges polarization separation unit 770' in the shape of a matrix like the polarization separation unit array 740 shown in drawing 8 . Polarization separation unit 770' is arranged so that the random polarization flux of light which carried out incidence may be divided into two kinds of polarization flux of lights in the direction of X like the polarization separation unit 770 shown in drawing 11 and polarization separation side 741' and reflector 742' may be located in a line in the direction of X. However, the magnitude of polarization separation unit array 740' is also small in the direction of Y compared with the polarization separation unit array 740 so that the magnitude of the direction of Y may be small and may correspond to condenser lens array 720' compared with the polarization separation unit 770 of drawing 11 , so that the magnitude of polarization separation unit 770' may be equivalent to the magnitude of condenser lens 721'.

[0135] Gobo 730' and selection phase contrast plate 750' are arranged by the magnitude and physical relationship corresponding to polarization separation unit array 740' like the relation between the gobo 730 to the polarization separation unit array 740, and the selection phase contrast plate 750. Moreover, also in joint lens 760', compared with the joint lens 760, the magnitude of the direction of Y is small.

[0136] As mentioned above, although the polarization lighting system 90 of this example has the description in the structure of each component in the 1st optical element 71' and 2nd optical element 72', since fundamental arrangement and the fundamental function of each component are the same as that of the 1st optical element 71 and the 2nd optical element 72 which are shown in drawing 8 , it omits explanation. Hereafter, explanation is further added about the structural description of each component in the 1st optical element 71' and 2nd optical element 72'.

[0137] The appearance configuration of flux of light division lens 711' is made into a configuration [**** / the configuration of the lighting field 4 / almost] so that the middle flux of light divided by flux of light division lens 711' may illuminate the lighting field 4 most efficiently. When the polarization lighting system 90 of this example is applied to a projection mold display like the projection mold display 80 (drawing 12), the lighting fields 4 are the liquid crystal equipments 411, 412, and 413. The aspect ratio (width:

length) of the liquid crystal equipments 411, 412, and 413 is 4:3, and the magnitude of the lengthwise direction of flux of light division lens 711' of this example is 3/4 of the lateral (the direction of X) magnitude LW. On the other hand, although the magnitude of the longitudinal direction of condenser lens 721' is the same magnitude as flux of light division lens 711', the magnitude of a lengthwise direction is 2/4 of the lateral magnitude LW. Hereafter, the reason is explained.

[0138] Drawing 19 is the explanatory view showing the secondary light source image (light source image) of the light source formed of flux of light division lens 711' and condenser lens 721'. Drawing 19 (A) is the explanatory view which saw from Y a part of condenser lens array 720 in the polarization lighting system 60 shown in drawing 8 , and polarization separation unit array 740, and drawing 19 (B) is the explanatory view seen from the Z direction. In addition, although a condenser lens 721 is shifted in the direction of Y a little and shown in it by drawing 19 (B) in order to make drawing intelligible, it is hardly shifted in fact. the polarization separation side 741 top where the middle flux of light 712 which passed the condenser lens 721 was constituted inside the polarization separation unit 770 with the flux of light division lens 711 and the condenser lens 721 — it is mostly condensed by the center position and the secondary light source image 713 is formed on the polarization separation side 741. Moreover, secondary light source image 713' of the almost same magnitude as the secondary light source image 713 is formed similarly on the reflector 742 constituted by the location near the direction of X of the polarization separation side 741. In addition, since the width of face from the plane of incidence of the polarization separation unit 770 to an outgoing radiation side is small, the magnitude of the cross section of the incoming beams in the polarization separation unit 770 and an outgoing beam is almost the same as the secondary light source image 713. Therefore, below, the magnitude of the cross section of those incoming beams and an outgoing beam is transposed to the magnitude of the cross section of the secondary light source image 713, and is explained.

[0139] If it separates into P polarization flux of light and S polarization flux of light simply in the condition of not completing the middle flux of light 712, the width of face of the whole flux of light after separation will spread twice, and will also enlarge optical system according to it. So, in the polarization lighting system 60, using the space where the light generated like the above-mentioned explanation by making two or more middle flux of lights 712 condense does not exist, the reflector 742 of the polarization separation unit 770 has been arranged, and enlargement of optical system is prevented. In the polarization lighting system 60, in consideration of the miniaturization of equipment, as shown in drawing 19 (B), magnitude of the direction of X of the field which projected the polarization separation side 741 on XY flat surface is made into magnitude almost equal to one half of the magnitude LW of the direction of X of a condenser lens 721 almost equally to the magnitude of the direction of X when projecting the secondary light source image 713 and 713' on XY flat surface. Similarly, magnitude of the direction of X of the field which projected the reflector 741 on XY flat surface is also made into magnitude almost equal to one half of LW(s). In addition, magnitude of the direction of Y of the field which projected the polarization separation side 741 on XY flat surface is made into magnitude almost equal to the magnitude (LW, 3/4) of the direction of Y of a condenser lens 721. Moreover, magnitude of the direction of Y on XY flat surface of the field where a reflector 741 exists is similarly made into magnitude almost equal to magnitude (LW, 3/4).

[0140] supposing the secondary light source image 713 project on XY flat surface and the cross section configuration of 713' be almost circular at this time, as show in drawing 19 (B), in the field of the direction of Y of the polarization separation unit 770, the field to the location which be distant from an upper limit and a lower limit only one eighth of magnitude LW in the direction of Y, respectively will become what (light do not exist in this field) be hardly use. In other words, a condenser lens 721 and the polarization separation unit 770 can make small only magnitude which corresponds in the direction of Y one fourth of magnitude LW, respectively. In the polarization lighting system 90 of this example, based on the reason for the above, as shown in drawing 19 (C), only magnitude (LW, 3/4) of the direction of Y of the condenser lens 721 which shows the magnitude of the direction of Y of condenser lens 721' to

drawing 19 (B) is made small (LW, 1/4). That is, magnitude of the direction of Y of condenser lens 721' is set to LW/2.

[0141] Since magnitude of the direction of Y of condenser lens 721' can be made small for the reason for the above, it is possible to also make condenser lens array 720' small [in the direction of Y] on the whole. However, in order to apply such condenser lens array 721', it is necessary to fabricate condenser lens 721' and flux of light division lens 711' further in a configuration which is explained below.

[0142] Drawing 20 is the explanatory view showing the structure of flux of light division lens 711' and condenser lens 721'. the flux of light — division — a lens — 711 — ' — being common — said — an alignment — a lens — 700 — X — a direction — an optical axis — LC — a core — magnitude — LW — width of face — cutting — Y — a direction — drawing 20 — (— A —) — being shown — two — a ** — a location — 711 — a — ' — 711 — b — ' — either — having cut — a rectangle — a lens — it is — a lens — a core — an optical axis — physical relationship — respectively — Y — a direction — having differed — a decentered lens — it is . 1st flux of light division lens 711a' is cut at XZ flat surface including the location based on [of this cardiac lens 700 / LC] lenses (optical axis), and the location which only distance (LW, 3/4) separated from the lens core LC to the direction upper part of Y. 2nd flux of light division lens 711b' is cut at XZ flat surface including the location which only distance (LW/4) separated from the lens core LC in the direction lower part of Y, and the location which only distance (LW, 2/4) separated from the lens core LC to the direction upper part of Y. In addition, other flux of light division lens 711c' and 711d' which are shown in drawing 18 (B) are equal to what carried out vertical reversal of flux of light division lens 711a' and 711b'.

[0143] a condenser lens — 721 — ' — being common — said — an alignment — a lens — 700 — X — a direction — an optical axis — LC — a core — magnitude — LW — width of face — cutting — Y — a direction — drawing 20 — (— B —) — being shown — two — a ** — a location — 721 — a — ' — 721 — b — ' — either — having cut — a rectangle — a lens — it is — a lens — a core — an optical axis — physical relationship — respectively — Y — a direction — having differed — a decentered lens — it is . 1st condenser lens 721a' is cut at XZ flat surface including the location which only distance (LW/8) separated from the lens core LC in the direction lower part of Y, and the location which only distance (LW, 5/8) left from the lens core LC to the direction lower part of Y. 2nd condenser lens 721b' is cut at XZ flat surface including the location which only distance (LW, 3/8) separated from the lens core LC in the direction lower part of Y, and the location which only distance (LW/8) separated from the lens core LC to the direction upper part of Y. In addition, other condenser lens 721c' and 721d' which are shown in drawing 18 (B) are equal to what carried out vertical reversal of condenser lens 721a' and 721b'.

[0144] Drawing 21 is the explanatory view showing the physical relationship of the direction of Y of flux of light division lens 711' and condenser lens 721'. the flux of light — division — a lens — 711 — a — ' — corresponding — a condenser lens — 721 — a — ' — the flux of light — division — a lens — 711 — a — ' — a lens — a core — 711 — a — ' — (— GC —) — a location — a condenser lens — 721 — a — ' — an optical axis — 721 — a — ' — (— OC —) — a location — being in agreement — while — the flux of light — division — a lens — 711 — a — ' — an optical axis — 711 — a — ' — (— OC —) — a location — a condenser lens — 721 — a — ' — a lens — a core — 721 — a — ' — (— GC —) — a location — being in agreement — as — arranging — having — **** . Similarly flux of light division lens 711b' and corresponding condenser lens 721b' the flux of light — division — a lens — 711 — b — ' — a lens — a core — 711 — b — ' — (— GC —) — a location — a condenser lens — 721 — b — ' — an optical axis — 721 — b — ' — (— OC —) — a location — being in agreement — while — the flux of light — division — a lens — 711 — b — ' — an optical axis — 711 — b — ' — (— OC —) — a location — a condenser lens — 721 — b — ' — a lens — a core — 721 — b — ' — (— GC —) — a location — being in agreement — as — arranging — having — **** .

[0145] condenser lens 721a which corresponds while the flux of light which carried out incidence is divided into flux of light division lens 711a' by flux of light division lens 711a' at middle flux of light 712a'

— ' — it deviates so that it may pass through a core mostly. In addition, middle flux of light 712a' divided by flux of light division lens 711a' shows only the chief ray in order to give explanation easy. if deflected middle flux of light 712a' passes condenser lens 721a' — flux of light division lens 711a' — it deviates so that it may become parallel to the travelling direction of the flux of light at the time of incidence, namely, so that a chief ray may become almost parallel to light source optical-axis 90R. Therefore, as for the location where outgoing radiation of middle flux of light 712a' is carried out from condenser lens 721a', middle flux of light 712a' has shifted to flux of light division lens 711a' rather than the location which carries out incidence at the light source optical-axis 90R side. Similarly, the location by which outgoing radiation is carried out from condenser lens 721b' also with middle flux of light 712b' will shift to flux of light division lens 711b' rather than the location which carries out incidence at the light source optical-axis 90R side. as mentioned above, two or more middle flux of lights 712 which carried out outgoing radiation from flux of light division lens 711' according to a deviation operation of the 1st optical element 71' and condenser lens array 720' — ' — An parallel shift is carried out in the direction of Y toward light source optical-axis 90R, and it becomes the flux of light compressed into 1st optical element 71' in the direction of Y to the flux of light which carried out incidence focusing on light source optical-axis 90R as the whole flux of light which passed condenser lens array 720'. That is, if its attention is paid to the cross-section dimension of the flux of light at the time of considering that the whole flux of light is a bundle, the dimension is small only in the direction of Y. thus — the flux of light — division — a lens — 711 — ' — and — a condenser lens — 721 — ' — respectively — being suitable — a decentered lens — ** — carrying out — while — being suitable — physical relationship — arranging — things — a condenser lens — an array — 720 (drawing 8) — comparing — overall — Y — a direction — a dimension — small — having carried out — a condenser lens — an array — 720 — ' — using — things — being possible .

[0146] According to the polarization lighting system 90 of this example, the following effectiveness is acquired. Drawing 22 is the explanatory view showing the light which carries out incidence on the projection lens 460 at the time of applying the polarization lighting system 90 to a projection mold display. Drawing 22 (A) is the mimetic diagram showing the function of the projection lens 460, and, in addition, shows physical relationship with the condenser lens array 720. The projection lens 460 can project effectively only the light which carried out incidence to lens pupil 460e shown in drawing 22 (A), and cannot project the light which carried out incidence outside lens pupil 460e. Furthermore, whenever [incident angle / which can be projected with the location of lens pupil 460e] (called a "swallowing angle") changes. Since it is in the inclination which becomes so small [whenever / this incident angle / is as large as the core of lens pupil 460e, and] that it goes on the outskirts, the use effectiveness of the light in a projection lens is in the inclination which gets so bad that the core of a lens is the best and goes on the outskirts.

[0147] Drawing 22 (B) arranges lamp unit 51B of polarization lighting-system 60A in the projection mold display 80 shown in drawing 12 like the polarization lighting system 90 to the sense whose lamp light shaft 51BL of the corresponds with system optical-axis 90L. The lamp light shaft 51BL is parallel to Y shaft orientations in lamp unit 51A. And luminous-intensity distribution 51ALP at the time of the outgoing radiation light from lamp unit 51A and lamp unit 51B passing the condenser lens array 720, and carrying out incidence to pupil 460e of the projection lens 460, when being arranged so that the opening may turn to a lower part, 51BLP is shown. In addition, luminous-intensity distribution 51ALP and 51BLP are shown by the contour line. As shown in drawing, the distribution core of luminous-intensity distribution 51BLP by lamp unit 51B centers on core 460L of a projection lens. On the other hand, luminous-intensity distribution 51ALP by lamp unit 51A is divided into two distribution 51ALP1 and 51ALP2 at XY flat surface including the distribution core, and is distributed over the direction outside of Y of luminous-intensity distribution 51BLP of lamp unit 51B. In addition, the lamp light shaft 51BL is parallel to X shaft orientations in lamp unit 51A, and when being arranged so that the opening may turn to the direction of X, luminous-intensity distribution 51ALP and 51BLP by lamp unit 51A and lamp unit

51B become the distribution which rotated drawing shown in drawing 22 (B) about 90 degrees. As mentioned above (refer to drawing 4), as for luminous-intensity distribution 51ALP and 51BLP of the lamp units 51A and 51B, those distribution core 51ALC (the distribution core of luminous-intensity distribution 51ALP1 and 51ALP2 is 51ALC1 and 51ALC2) and near 51BLC are the strongest, and they are in the inclination which decreases so rapidly that it goes on the outskirts.

[0148] On the other hand, the use effectiveness of the light of a projection lens is in the inclination which gets so bad that the lens core is the best and goes on the outskirts as mentioned above. Therefore, although the quantity of light of the illumination light as a lighting system increases as a whole when two lamp units are used as the light source of a lighting system, the use effectiveness of the light as the whole projection mold display is not so good.

[0149] In the projection mold display which applied the polarization lighting system 90 of this example As shown in drawing 22 (C), by the 1st optical element 71' and condenser lens array 720' Luminous-intensity distribution 51ALP' and 51BLP' (51ALP1', 51ALP2') by the lamp units 51A and 51B Compared with luminous-intensity distribution 51ALP and 51BLP in drawing 22 (B), it is compressed in the direction of Y focusing on core 460L of a projection lens. Therefore, each distribution core 51ALC' and 51BLC(s)' will also exist in a near location by core 460L of a projection lens compared with the location of each distribution core 51ALC in drawing 22 (B), and 51BLC(s). Therefore, the projection mold display which applied the polarization lighting system 90 of this example can raise the use effectiveness of the light in a projection lens compared with the projection mold display which applied a lighting system like polarization lighting-system 60A, and can indicate the brighter projection image by projection.

[0150] Moreover, if it is made to enlarge the corresponding reflective mirrors 551 and 552 while increasing the number of arrays of flux of light division lens 711' and enlarging lamp unit 51A and 51B so that condenser lens 721' may be arranged also to the shadow area shown in drawing 22 (C) and it may correspond to it at this, the still brighter projection image can be indicated by projection.

[0151] Like condenser lens array 720″ shown in drawing 23 , condenser lens 721″ of the direction periphery of X can be made still smaller in the direction of Y than condenser lens 721' of a center section. Drawing 24 shows the dimension configuration of the actual secondary light source image of two or more middle flux of lights formed near condenser lens array 720', when the lamp units 21A and 21B of polarization lighting-system 60A in the projection mold display 80 shown in drawing 12 are arranged in the direction of Y. As shown in drawing 24 , depending on the formation location, the dimension and configuration of a secondary light source image differ from each other, centering on the lamp, the secondary light source image of the near flux of light is large, and the secondary light source image of the flux of light which is distant from a lamp core is small. therefore — a lamp — a unit — 51 — A — and — 51 — B — a lamp — a core — 51 — ALC — ' (51ALC1', 51ALC2') — and — 51 — BLC(s) — ' — from — having separated — a location — it is — a periphery — a condenser lens — 721 — ″ — drawing 23 — being shown — as — Y — a direction — further — small — carrying out — if — these — a rectangle — a lens — having passed — the flux of light — receiving — projection — a lens — use — effectiveness — further — improving — it can make — a still brighter projection image — a projection display — it can carry out — . Of course, although condenser lens array 720' shown in drawing 18 shows the example which made only the Uichi Hidari train small among the rectangle lenses of four trains, it is not limited to this and you may make it change magnitude for every train with the magnitude of a secondary light source image.

[0152] In addition, in the polarization lighting system 90 of this example, although the case where the aspect ratio of condenser lens 721' is set to 2:1 is shown in the example when the aspect ratio of flux of light division lens 711' is 4:3, it is not limited to this. the secondary light source image which is condensed with a flux of light division lens, and is formed in the polarization separation side of a polarization separation unit, and a reflector in short — compared with the aspect ratio of a flux of light division lens, what is necessary is just made to make the aspect ratio of a condenser lens small so that all may almost be included at least

[0153] In addition, even if it uses the lamp unit equipped with the reflector to which the side cut as shown in drawing 7 was given as each lamp units 51A and 51B, the same effectiveness as the above can be acquired.
[0154] Moreover, also in the polarization lighting system 90 of this example, since it has integrator optical system and a polarization generator as well as the polarization lighting system 60 of the gestalt (drawing 8) of the 2nd operation, as the gestalt of the 2nd operation explained, the effectiveness by using integrator optical system and the effectiveness by using a polarization generator can be acquired.
[0155] Moreover, also in the polarization lighting system 90 of this example, if both light source lamps are considered as the configuration which can be turned on alternatively, since the brightness of the illumination light can be adjusted to a multistage story if needed, various usage can be done in respect of the brightness demanded or consumed electric power.
[0156] Moreover, when using the lamp unit equipped with the light source lamp with which spectrums differ, for example and it applies to a color projection mold display, there is also an advantage of being able to improve the color reproduction nature.
[0157] In addition, although this example explains the case where lamp unit 51B is arranged at the sense whose lamp light shaft 51BL corresponds with system optical-axis 90L, and it is arranged so that lamp unit 51A may have lamp light shaft 51BL parallel to Y shaft orientations and the opening may turn to a lower part to the example, it is not limited to this. What is necessary is in short, just to arrange two lamp units and a synthetic mirror so that the outgoing radiation light from each lamp unit may be compounded along a direction (lengthwise direction) perpendicular to the longitudinal direction (longitudinal direction) of a lighting field. And what is necessary is just made to make small magnitude of the lengthwise direction of a condenser lens array (2nd lens plate) to it of a flux of light division lens array (1st lens plate). That is, the various arrangement relation of two lamp units as shown in drawing 6 is also possible.
[0158] (Gestalt of operation of others of this invention) Although the projection mold display 80 which was mentioned above and with which polarization lighting-system 60A of the same configuration as the polarization lighting system 60 was incorporated with the gestalt of the 3rd operation was explained, it is also possible to adopt a lighting system 10, as shown in drawing 1 instead of lighting-system 60A of the projection mold display 80. Furthermore, it is also possible to adopt the lighting system which has the lighting which has the light source section as shown in drawing 6 and drawing 7 . If light source section 5' especially shown in drawing 7 is adopted instead of the light source section 5 of the projection mold display 80, since the light source section itself is small, it will become possible to miniaturize a projection mold display.
[0159] Moreover, although the gestalt of each above-mentioned operation explained only the example which adopted the lighting system of this invention as the projection mold display which used the liquid crystal equipment of a transparency mold, the lighting system of this invention is applicable also like the projection mold display which used the liquid crystal equipment of a reflective mold.
[0160] Furthermore, although the thing of the rear mold which projects an image from the direction where the front mold which projects an image and the side which a projection side observes are opposite exists in the display of a projection mold from the side which observes a projection side, this invention can be applied to all.
[0161] In addition, this invention can be carried out in various modes in the range which is not restricted to an above-mentioned example or an above-mentioned operation gestalt, and does not deviate from that summary.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the outline block diagram showing the optical system of the lighting system concerning the gestalt of operation of the 1st of this invention.

[Drawing 2] It is the explanatory view showing outgoing radiation quantity of light distribution of the direction which intersects perpendicularly with the lamp light shaft in each lamp unit of the light source section of drawing 1 .

[Drawing 3] It is the outline perspective view showing the configuration of the 1st lens plate which constitutes the integrator optical system of drawing 1 .

[Drawing 4] It is the explanatory view showing the wavelength distribution property of the illumination light in the lighting system of drawing 1 .

[Drawing 5] It is the explanatory view showing the illumination-light generating mode in the lighting system of drawing 1 .

[Drawing 6] It is an explanatory view to show the modification which consists of combination of the arrangement relation of the lamp unit of the pair which constitutes the light source section of drawing 1 , and the configuration of a synthetic mirror optics system.

[Drawing 7] It is the outline block diagram showing the optical system of the lighting system constituted using the lamp unit to which the side cut was given.

[Drawing 8] It is the outline block diagram showing the optical system of the polarization lighting system concerning the gestalt of operation of the 2nd of this invention.

[Drawing 9] It is the perspective view of the gobo of drawing 8 .

[Drawing 10] It is the perspective view of the polarization separation unit array of drawing 8 .

[Drawing 11] It is drawing for taking out the polarization separation unit which constitutes the polarization separation unit array of drawing 8 , and explaining the function.

[Drawing 12] It is the outline block diagram showing the optical system of the projection mold display concerning the gestalt of operation of the 3rd of this invention.

[Drawing 13] It is the outline perspective view showing the modification of a lamp unit.

[Drawing 14] It is the sectional view of the lamp unit of drawing 13 .

[Drawing 15] It is the explanatory view showing the arrangement relation between each lamp unit when Y shaft orientations are countered and each lamp unit has been arranged, and a dichroic mirror.

[Drawing 16] It is the explanatory view showing the arrangement relation between each lamp unit when X shaft orientations are countered and each lamp unit has been arranged, and a dichroic mirror.

[Drawing 17] It is the graph which shows the color separation property of a blue light green light reflex dichroic mirror.

[Drawing 18] It is the outline block diagram showing the optical system of the polarization lighting system concerning the gestalt of operation of the 5th of this invention.

[Drawing 19] It is the explanatory view showing the secondary light source image of the light source formed with the flux of light division lens and condenser lens of drawing 18 .

[Drawing 20] It is the explanatory view showing the structure of the flux of light division lens of drawing 18 , and a condenser lens.

[Drawing 21] It is the explanatory view showing the physical relationship of the direction of y of the flux of light division lens of drawing 18 , and a condenser lens.
[Drawing 22] It is the explanatory view showing the light which carries out incidence on the projection lens at the time of applying the lighting system of drawing 18 to a projection mold display.
[Drawing 23] It is the explanatory view showing other examples of a configuration of the condenser lens array of drawing 18 .
[Drawing 24] It is the explanatory view showing the actual secondary light source image of two or more middle flux of lights formed near the condenser lens array of drawing 18 .
[Description of Notations]
10 — Lighting system
10L — System optical axis
3 — Integrator optical system
31 — 1st lens plate
311 — Rectangle lens
32 — 2nd lens plate
321 — Microlens
33 — Field lens
4 — Lighting field
5 5' — Light source section
51 — Lamp unit
51A, 51A' — Lamp unit
51B, 51B' — Lamp unit
511A, 511B — Light source lamp
512A, 512B — Reflector
52 53 — Lamp light shaft
55 — Synthetic mirror optics system
551,552 — Reflective mirror
56 — Removable unit
51C — Lamp unit
51L — Lamp light shaft
511C — Light source lamp
512C — Reflector
515 — Circular opening
513,514 — Reflective mirror
54 — Lamp light shaft
513a, 514a, 516 — Reflector
60 — Polarization lighting system
60A — Polarization lighting system
60L — System optical axis
90 — Polarization lighting system
90L — System optical axis
7 7' — Polarization generator
71 71' — The 1st optical element
711,711' — Flux of light division lens
711a' and 711b — '711c', 711d' — flux of light division lens
72 72' — The 2nd optical element
720,720', 720″ — Condenser lens array
721,721', 721″ — Condenser lens
721a' and 721b — '721c', 721d' — condenser lens

730,730' — Gobo
731 — Face shield
732 — Effective area
740,740' — Polarization separation unit array
770,770' — Polarization separation unit
741,741' — Polarization separation side
742,742' — Reflector
743 — P outgoing radiation side
744 — S outgoing radiation side
745 — P polarization flux of light
746 — S polarization flux of light
750,750' — Selection phase contrast plate
760,760' — Joint lens
712,712' — Middle flux of light
713,713' — Secondary light source image
73 — Reflective mirror
751,751' — lambda / 2 phase-contrast plate
80 — Projection mold display
400 — Color separation optical system
401 — Blue light green light reflex dichroic mirror
402 — Green light reflex dichroic mirror
403 — Reflective mirror
411 — Liquid crystal equipment for red sunset (transparency mold)
412 — Liquid crystal equipment for **** (transparency mold)
413 — Liquid crystal equipment for blue lights (transparency mold)
430 — Light guide optical system
431 — Incidence lens
432 — Relay lens
433 — Outgoing radiation lens
435,436 — Reflective mirror
450 — Cross dichroic prism
451 — Red sunset reflective die clo IKKU side
452 — Blue light reflective die clo IKKU side
460 — Projection lens
470 — Screen
100 — Lighting system
110 — Light source section
110A, 110B — Lamp unit
110AL(s), 110BL — Lamp light shaft
120A, 120B — Light source lamp
130A, 130B — Reflector

[Translation done.]